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THE USE OF AUTOMATIC APPLIANCES.

The ease with which apparatus may be controlled electrically at a distance and may be made to perform certain definite operations in a prescribed way, is demonstrated by the increasing tendency to use automatic apparatus. This tendency leads not only to greater convenience, but is actually safer. The motorman of the modern electric car only starts the car; the controller itself decides the rate at which the car accelerates. The same is true in elevator practice and in many other lines of motor application.

The tendency to use automatic apparatus more and more in central station operation is also doing much to improve the service of these plants and to increase their reliability. We have automatic switches, automatic alarms of various kinds, and now we have an automatic synchronizer, a device which performs the delicate operation of coupling alternators together with a celerity and surety which can not be expected of the human operator.

A MUNICIPAL OWNERSHIP SETBACK.

When Mr. James Dalrymple, the managing expert of Glasgow's street railway system, arrived in this country, at the call of the mayor of Chicago, the advocates of municipal ownership of public utilities welcomed him with open arms. His opinions were quoted everywhere, and the report of the investigation he was to make of conditions in Chicago was awaited with impatience, it being thought that his report would allay the fears of those timid ones who hesitate to commit their cities to expensive undertakings, the outcome of which is doubtful. Mr. Dalrymple said, to quote his own words: "I see no reason why Chicago or any other city in this country should not be able to own its street railways and run them with as much success as we have achieved in Glasgow." Theoretically, perhaps he was right, although the wisdom of extending the functions of the government may be questioned. But at the present time the most pressing question is whether our governments are ready to take up new cares. Chicago was not alone in being deeply interested in the subject, for the same question was being agitated in a number of the larger cities.

Fortunately for all of us, or at least for those who are not yet convinced that municipal ownership will accomplish all that is being claimed for it, Mr. Dalrymple is an honest and disinterested expert. He has investigated the conditions, not only in Chicago but in New York and elsewhere, and he is thoroughly convinced that municipal ownership would not be successful in our cities. Mr. Dalrymple not only believes that political conditions, as they exist to-day, would make municipal ownership a failure, but he holds that a strict application of the principles of civil service would be almost as disastrous. Civil service rules could not be applied successfully because, in his opinion, an examination on paper can not decide the suitability of a man for the position of motorman or conductor; and, moreover, the superintendent of the road must have the power to discharge an employé if he is incapable.

That Mr. Dalrymple's opinion will carry weight may be expected, since he has nothing to gain and may fairly be considered to be impartial and to be speaking from conviction. In fact, there seems to be a healthy reaction against municipal ownership, at least on the part of the conservative and influential daily papers. They see the perils ahead, and do not hesitate to point them out. It seems strange, indeed, as the New York *Times* remarks, that municipal ownership should be advocated so readily by political organizations having at heart the betterment of our governments. These bodies do not seem to realize that to give a city government control of the public utilities would be only adding powerful weapons to the already well-armed practical politicians—the men who govern us for themselves.

THE THREE-PHASE RAILWAY SYSTEM.

The work of driving a railway car or train is peculiar in several respects: motors must operate successfully under varying conditions of load and of power supply; they must be rugged, able to stand sudden and severe overloads, and require not much attention, even though exposed to unfavorable conditions. The experience of the first few years in street railway work showed that the simplest type of motor was the best for conditions as they then existed, hence the adoption of the direct-current series motor. But as electric traction was extended to wider fields and applied to heavier work, the limitations of the direct-current motor were recognized, and other types were considered to see whether their characteristics would make them more suitable for newer problems. At the present time every type of electric motor known has been proposed and tried for railway service, and several new types have been developed in the effort to secure a machine which will meet the requirements of railway work as they are now understood.

The direct-current shunt motor, although abandoned after a brief trial in the early days, has since been considered again, but has not met with much favor among railway men. Its chief claims for recognition are greater range of speed variation, and the possibility of returning power to the line when braking or descending grades.

Among the alternating-current motors a greater selection is offered. Of the types available previous to the last three years, neither appealed to the American engineer. The synchronous motor could not be used without auxiliary apparatus, and the induction motor, as then constructed, had characteristics which did not seem to suit it to the work. But the convenience and economy of alternating-current transmission were thought by some to overbalance the poorer characteristics of the motor for traction service when comparing it with the direct-current type. In Italy the three-phase induction motor was supplied for the Valtellina road. The system has been in operation for a number of years, and recently several new locomotives have been added to this equipment, a description of which will be found on another page of this issue. Mr. B. J. Arnold, who persistently urged the application of alternating currents to railway work, has devised an ingenious gearing system which enables him to operate a locomotive by means of a single-phase, alternating-current motor, whether it be of the induction or synchronous type.

The newer types of alternating-current motor partake of the character of the series direct-current motor, but are more complicated in that it is necessary to add a compensating winding, or to adopt some other device for improving the power-factor of the motor. There are several types of these motors. All employ a commutator, and all have two or more field windings, which may be in series with the armature or in shunt and in series with the armature. The repulsion type, with compensating windings, has been tried, but is thought to be less suitable than the series type. Certain types are, in fact, a combination of the series and the repulsion types. Of these various types, some must be the more suitable. Which they are time alone will tell.

The new Valtellina locomotive differs principally from the older types in the design of the motor. Each driving unit is in fact a double motor, the two parts of which may be connected in concatenation for obtaining a reduced speed. The method of transmitting power from the motor to the axles is also different from that used in any recent electric locomotive. The earlier locomotives were of the gearless type, with the axle passing through the hollow shaft of the rotor. This construction presented certain mechanical difficulties, and did not permit easy inspection. But instead of adopting gears, as would naturally have been expected under the circumstances, it was decided to use the coupling and connecting rods of the steam locomotive. This design made it imperative that the speed of the motor should be no higher than that of the locomotive axles, hence large motors were required, and all the space available between wheels was needed for the motor proper, and the designers were forced to place the slip rings used in controlling the speed on a return crank outside of the main driving crank. It is questionable whether this method of driving does not offset largely the reduction in the size of the motor which might have been possible since the high voltage of the line is applied directly to the motors. The method of driving also produces certain unbalanced forces. As the speed of the Valtellina locomotive will not be high—at the most not over thirty-eight miles an hour—it may be that this pounding effect will be of little consequence.

A noteworthy feature of the new locomotive is the method of control. This is accomplished by means of compressed air, which operates the various switches, collecting devices and the regulating resistances. The engineer from his position in the cab by this means has control of all the apparatus in the locomotive.

The distributing system requires two overhead conductors, and is somewhat more complicated than the single-phase systems which are being tried elsewhere. The locomotive itself is fully as complicated as those equipped with single-phase motors. There seems to be no gain in this respect; indeed, rather the reverse. The efficiency of operation, as far as regards starting and normal running, is probably no better than that which can be obtained with the commutating types of motor. The speed regulation is no better than that which can be secured in the newer types with series-parallel control; in fact, it permits of but two speeds, while certain of the single-phase systems can run efficiently at a number of speeds. One advantage possessed by the system is the ability to return power to the line when braking or when descending grades; but it is not the only alternating-current system which possesses this advantage. However, the characteristics of the induction motor, resembling as they do those of the direct-current shunt motor, have seemed to certain engineers to make this machine particularly suitable for heavy long-distance hauls, and the results of the operation of the new machines on the Valtellina road will probably throw much light upon the suitability of this type for main-line service.

ELECTRIC HEATING.

A correspondent who is fortunate enough to have some 300-horse-power, hydraulic horse-power, more than he needs contemplates disposing of this for heating purposes, and writes for information concerning electric heaters.

An electric heater is essentially a simple device. By far the greater number of heaters are of the so-called resistance type, in which a conducting path of fairly high resistance is provided for the current so that the latter, in its passage through the heaters, converts all of its available energy into heat. However the shape of the heating element itself, and the material of which it is made, may vary within wide limits; the shape of the complete heater may also vary greatly, and is largely determined by the purpose for which it is intended.

If a heater is to be supplied for warming a room, it will, in general, be rather large, and the temperature which it acquires not excessively high. As the heat is conveyed throughout the room by the air, and not by direct radiation, the surface of the heater must be such as to give up its heat readily to the surrounding air. The conducting material through which the current is passed, and which becomes hot for that reason, may consist of a metallic wire, or the electrical conductor may consist of an exceedingly thin layer of metal supported by a non-conducting strip or plate. In one well-known type of heater the heating elements are merely special forms of incandescent lamps. These, in addition to heating the surrounding space, are thought to be more cheerful because of the accompanying glow. For temporary purposes an excellent heater can be made of coils of iron wire strung on a frame, iron wire being preferable to copper because of its higher specific resistance. In a new type of heater the conducting material takes the form of a powder distributed over a non-conducting support. When metallic wires are used they are frequently surrounded by an inactive powder, which protects them from the air and thus avoids oxidation.

Heaters for cooking purposes must develop fairly high localized temperatures, hence they are in general smaller than heaters for warming rooms. The heater of an electric stove is generally arranged so as to give off practically all the heat in a small space, upon which the cooking utensil can be placed; or the cooking utensil itself may contain the heating element. Herein lies one of the great advantages of electric stoves. There is practically no loss of heat, all that developed by the stove or the cooking utensil being given to the substance to be heated. The other desirable features of electric cooking stoves are the convenience, cleanliness and absence of smoke and foul gases. The stove is started by merely turning a switch and in a moment or two it reaches its full temperature. Any degree of regulation can be secured, and this without loss, for all of the electrical energy delivered to the heater is converted into heat.

The advantages given here for the electric stove apply equally as well to heaters for other purposes. They are instantly and easily controlled, and, when properly installed, they are good fire risks. When installing them, however, it should be remembered, as is true of steam and hot-water heating systems, that ventilation must be provided for the room, since the heater itself does not supply fresh air.

The energy supplied to the heater can be measured in kilowatt-hours or in horse-power-hours. The first corresponds to 3,412 British thermal units, or to an evaporation of 3.53 pounds of water per hour from and at 212 degrees Fahrenheit. If electrical energy is measured in horse-power, one horse-power-hour is equivalent to 2,544 British thermal units, and will evaporate 2.64 pounds of steam from and at 212 degrees Fahrenheit. The temperature attained by the heater depends, of course, upon many things: upon the power supplied; upon the size and material of which the heating element is made; upon the kind and shape of the enclosing case—if any be used—and upon its position with regard to surrounding objects. Any temperature may be attained in the heater up to that required to melt the most infusible metals.

The art of electric heating is well developed, though the use of these appliances for heating rooms and cooking is not as great as could be desired. The fault here lies not in the heaters themselves, but in the fact that in generating electrical energy from coal great losses take place. The method is roundabout, and the only system available to-day is, unfortunately, inefficient. First, we burn the coal and transfer as much as possible of the heat developed by this process to water. The steam thus generated is then passed to some type of engine. The engine drives an electric generator, which, in turn, develops electric current. This current must then be transmitted, through conducting wires, to the point where it is to be utilized, where its energy is reconverted into heat. At every step, except the last, losses take place, not so much due to our apparatus as to the system itself. But, in spite of these losses, there are so many desirable features possessed by electric heating apparatus that it is confidently expected its use will increase every year. Many electric generating stations to-day encourage the use of electric heaters by supplying the current for them at reduced rates.

ELECTRIC ELEVATORS.

On another page of this issue appears an article by Mr. E. R. Carichoff, entitled "Fundamental Features of Electric Elevators." This is the first of a number of articles which Mr. Carichoff is writing for the ELECTRICAL REVIEW. The series will cover the field of electric elevator service. The various systems will be described, and the method of control and the various safety devices employed will be explained in detail.

Mr. Carichoff is a recognized authority upon electric elevators. He has been actively employed in elevator work for many years past, having been among the first to engage in the development of the electrically controlled system. He was associated with Mr. Frank J. Sprague in 1893. In 1900 he accepted a position as consulting engineer with the Otis Elevator Company, and at the present time he is consulting engineer for the National Elevator and Machine Company. His wide experience makes him familiar with all elevator systems, and his series of articles will not only be authoritative, but, we believe, will be the first to discuss fully and satisfactorily this exceedingly important application of the electric motor and the electrically operated elevator controller.

THE ANNUAL CONVENTION OF THE NATIONAL-INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

THE HON. S. P. SHEERIN DIES WHILE DELIVERING THE RESPONSE FOR THE ASSOCIATION.

[*Special Telegram to the* ELECTRICAL REVIEW.]

CHICAGO, ILL., June 20—The first annual convention of the National-Interstate Independent Telephone Association opened at the Auditorium, Chicago, Ill., at 10.30 A. M. City Prosecutor Taylor, representing the mayor of Chicago, welcomed the delegates. The Hon. S. P. Sheerin, president of the Indianapolis Telephone Company, arose to respond for the association. In the middle of his address he paused and, stepping to Chairman Powers, said: "I beg your pardon, Mr. Chairman, but I am faint." Colonel Powers immediately sprang to his feet and caught Mr. Sheerin, who sank slowly to the floor. He expired in about half an hour. The cause was apoplexy. The meeting adjourned until three o'clock in the afternoon.

The executive committee held a meeting at noon, and decided to hold one later in the afternoon. At that time a committee on resolutions will be appointed to take proper action on the demise of Mr. Sheerin. The convention will then adjourn until Wednesday at 9 A. M., when, after proper resolutions have been presented, and necessary business undertaken, the convention will adjourn out of respect for Mr. Sheerin.

The exhibits were closed for the day, and the banquet has been abandoned.

The committee in charge of the convention gave out the following announcement at noon:

The Hon. S. P. Sheerin suffered a fatal attack of apoplexy at 11.15 A. M., while in the convention hall responding to the address of welcome. Medical attendance was had after some delay, and the physician reported Mr. Sheerin dead. The remains will be taken to Indianapolis tonight for interment. Mr. Sheerin was fifty-nine years of age, and president of the New Long-Distance Company, of Indianapolis. He had long been identified with the work of the Independent Telephone Association, and was one of the most prominent financiers and operators in the field. He had been secretary of the National Association, and had served on all the advisory committees of the association since its organization. From 1880 to 1886 he was clerk of the Supreme Court of Indianapolis. From 1888 to 1896 he was secretary for the national executive committee of the Democratic party. Mr. Sheerin was one of the heaviest investors in independent telephone properties, and, with a few associates, controlled the independent telephone properties of Indianapolis. The deceased leaves a wife and eight children. Thomas D. Sheerin, the eldest son of Mr. Sheerin, was attending the convention with his father, and was present at the meeting when his father was stricken. L. W. M.

New York Electrical Society.

The New York Electrical Society held its twenty-fourth annual meeting at the Café Boulevard, on June 14. The meeting was preceded by a dinner to which eighty members and their friends sat down. In the absence of President F. J. Sprague in Europe, Vice-President F. C. Bates presided. Mr. Bates, in a short but most effective speech, touched on some of the special features of the season, and their evidences of the wider representation which the society is now securing. Mr. Bates noted as of pleasing significance the fact that one of the tables containing over twenty guests was occupied almost entirely by telephone men. Furthermore, members of nearly every branch of electrical industry were to be found in the company present. There was, however, one most important section, that of street railway work, which ought to be more fully represented in the membership of the society, and it was gratifying to believe that in this direction the placing of the name of Mr. H. G. Stott on the nomination list was a happy augury. The finances and the membership list of the society were in sound and vigorous condition, and there were even now signs that the coming year will be the most successful in the history of the society. More than half of an exceptionally fine series of lectures had already been arranged for, and the organization of plans for an active campaign in the adding of new members was well on the way. Mr. Bates concluded by congratulating the society not only on its most encouraging present, but also on its possibilities in the near future.

The secretary's report showed that forty-six members had been elected during the season; the loss by death had been four, by resignation twenty-five, ten had been dropped, and the total existing membership was 636.

The report of the treasurer showed a steady improvement in the finances of the society.

The officers elected were:

President, W. S. Barstow.

Vice-presidents, H. G. Stott, Putnam A. Bates, Max Loewenthal.

The vice-presidents elected in 1904 for two years are Albert F. Ganz, Louis B. Marks, W. S. Rugg.

Secretary—George H. Guy.

Treasurer, H. A. Sinclair.

The excellent musical programme was admirably supplemented by the artistic singing of Mr. Charles Stuart Phillips.

Production and Value of Copper, Lead and Spelter in the United States During 1904.

Mr. Charles Kirchhoff, special agent of the United States Geological Survey, has computed the quantity and value of the copper, lead, and spelter produced in the United States during 1904. He has in preparation detailed reports of these industries, which will be published in the Survey's forthcoming volume "Mineral Resources of the United States, 1904."

A very considerable increase took place in the production of copper during 1904. The production amounted to 812,537,267 pounds, valued at $105,629,845. The production for 1903 was 698,044,517 pounds. The most noteworthy increase occurred in Arizona, where both the Bisbee and Globe districts added largely to the product. The imports in ore and matte amounted to 38,947,772 pounds; the imports in bars, ingots, and old bars to 142,344,433 pounds. The exports of copper amounted to 564,544,880 pounds, a noticeable increase over the exportation of 1903, which was only 320,322,627 pounds. The amount of copper consumed in the United States during 1904 was 485,284,592 pounds, a decline from the figure for 1903, which was 566,429,885 pounds. In spite, however, of this decrease in consumption, it was necessary to draw upon the stocks in producers' hands to the extent of nearly 56,000,000 pounds.

To arrive at the production of merchant lead obtained from the mines of the United States is a complicated problem. A careful study of the figures justifies the statement, however, that it amounted to 307,000 short tons in 1904, valued at $26,402,000. The yield in pig lead from ores smelted by works that treat argentiferous material is estimated, after undergoing the smelting, desilverizing, and smelting operations, at ninety-five per cent of the contents of the ores. The result is a tonnage of 218,000 for 1904 as contrasted with 199,000 short tons for 1903. To these figures are added 89,169 tons of soft lead for 1904 and 83,444 tons of soft lead for 1903, making an approximate total of 307,000 short tons for the lead production of the United States in 1904, as compared with 282,000 short tons for 1903.

Returns from all the producers of spelter in the United States show that the production for 1904 amounted to 186,702 short tons, valued at $18,670,200. The production of 1903 was 159,219 short tons. This extraordinary increase in output was due chiefly to the growth of the industry in Kansas, where a number of new plants built in 1903 were in full operation. A partial report of the stock carried by producers of zinc shows a reduction from 10,538 short tons on January 1, 1904, to 6,521 short tons on January 1, 1905.

The Twenty-second Annual Convention of the American Institute of Electrical Engineers.

Asheville, N. C., June 19 to June 23.

By Telegraph to the Electrical Review.

ASHEVILLE, N. C., June 19—The twenty-second annual convention of the American Institute of Electrical Engineers opened at Asheville, N. C., June 19, under exceptionally pleasing circumstances. The greater number of the 200 who have so far arrived reached Asheville about three o'clock Sunday afternoon, and were met at the station by Chairman C. E. Waddell and other members of the local committee. Open cars were provided for conveying the visitors to their hotels, the headquarters being established at the Battery Park Hotel.

Sunday evening was given up to resting. All of the visitors were greatly delighted by the beautiful surroundings and the magnificent scenery. The local committee was most solicitous for the comfort and pleasure of its guests.

MONDAY MORNING SESSION.

On Monday the members of the Institute assembled in the ladies' ballroom at the Battery Park Hotel for the first session of the convention.

President John W. Lieb, Jr., called the meeting to order at 9.30 A. M., and introduced Chairman Waddell of the local committee. Mr. Waddell introduced Mayor A. S. Barnard, who welcomed the guests to Asheville. He said, in part: "The duty which devolves upon me is a pleasurable one, as I esteem it a great privilege to meet the members of an organization which is doing so great a work. The South is rapidly developing, manufactures are spreading, and the Institute comes at an opportune time. The work of such organizations is fast obliterating those barriers imagined to exist between this and other sections of the country. The South has not been backward in adopting electrical methods. Asheville was one of the first cities to install an arc-lighting system."

He then extended a hearty welcome to the members of the Institute, saying that, although the formal act devolved upon him, the citizens themselves had assumed the responsibility for the proper care of their visitors.

President Lieb thanked the mayor for his kind words, on behalf of the Institute, and then presented the annual address. This takes up the question of Institute development, dealing particularly with classification of members, and comparing the Institute rules with those of the other national engineering societies. He makes a number of valuable suggestions for raising the standing of the Institute, and suggests a new class of membership for those who have distinguished themselves in their profession, but who are not practising engineers.

At the close of the address Professor W. E. Goldsborough, of New York city, offered resolutions referring the suggestions made to the board of directors. The resolution was seconded by Dr. C. P. Steinmetz, of Schenectady. Calvin W. Rice offered an amendment that the secretary be directed to bring the address to the attention of the board at the first September meeting. The resolution was adopted as amended.

The formal reading of papers was then taken up. Dr. Steinmetz read his paper, entitled "High Power Surges in Electrical Distribution Systems of Great Magnitude." This was followed by a paper presented by Mr. Percy H. Thomas, on "An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances Such as Switches Grounding, Etc."

These two papers were discussed by H. G. Stott, of New York; P. N. Nunn, Niagara Falls; S. M. Kintner, Pittsburg; F. A. C. Perrine, New York city; H. W. Fisher, Pittsburg; J. W. Lieb, Jr., New York city, and Dr. Samuel Sheldon, Brooklyn.

Dr. Steinmetz read his paper on "The Constant-Current Mercury Arc Rectifier." This was discussed by J. W. Howell, Harrison, N. J.; Dr. E. F. Northrup, Philadelphia; P. H. Thomas and F. A. C. Perrine, New York city.

During the afternoon carriages were provided which took the guests through Biltmore, the beautiful estate of Mr. George W. Vanderbilt.

MONDAY EVENING SESSION.

In the evening a second business session was held, at which Mr. H. W. Fisher read a paper on "Data Relating to Electric Conductors and Cables." This paper was discussed by H. G. Stott, C. W. Rice, C. O. Mailloux, F. A. C. Perrine and C. P. Steinmetz.

Mr. S. M. Kintner read a paper on "Methods of Measurement of High Electric Pressure," which was discussed by C. P. Steinmetz, Samuel Sheldon, C. O. Mailloux, H. G. Stott, E. F. Northrup and C. A. Perkins.

J. W. Howell read a paper on "Comments on the Remarks Made by Colonel R. E. B. Crompton before the International Electrical Congress at St. Louis." There was no discussion on this paper.

C. E. Waddell read a paper, which was illustrated by lantern slides. W. H. B.

Evening Courses in Electric Transportation.

The Polytechnic Institute of Brooklyn, Brooklyn, N. Y., has announced a series of evening courses in physics and electrical engineering at the Polytechnic Institute, 85 Livingston street, for the season 1905-6. The lectures will start promptly at 7.30 in the evening, with the exception of the course in electric transportation. The fee for the course in electric transportation, including tests, is $15. When taken in connection with the course in transportation offered by the department of mechanical engineering, the fee for the two courses is $25. The fees for the courses are at the rate of forty cents an hour for ten hours or under, thirty-five cents an hour for 100 to 200 hours, and thirty cents an hour for 200 or more hours. The course includes fourteen two-hour lectures and five extensive tests on electric transportations, fifteen lectures on electric train movements, fifteen two-hour lectures on alternating currents, fifteen two-hour lectures and recitations on mechanics and heat, and twenty two-hour laboratory tests on alternating-current generators and motors.

A folder entitled "Where Health and Pleasure Wait" has been issued by the passenger department of the New York Central & Hudson River Railroad Company. The folder is intended to give an idea of the hundreds of places which are served by this system. The folder contains many illustrations of lake, mountain and sea resorts, all of which are easily reached. Copies of this folder will be sent to any address upon receipt of a two-cent stamp, by George H. Daniels, general passenger agent, Grand Central Station, New York city.

BOOK REVIEW.

"The Steam Engine." Robert C. H. Heck, M.E., assistant professor of mechanical engineering, Lehigh University. New York. D. Van Nostrand Co. Cloth. 391 + viii pages. 6¼ by 9¼ inches. 188 illustrations. Supplied by the ELECTRICAL REVIEW at $3.50.

The objects of this book are, as stated by the author in the preface, "to set forth clearly the fundamental principles of the steam engine, to give a broad description of constructive practice, to explain fully the working of the machine in its several departments, and to show how to find its efficiency in performance. Manner of presentation and order in development of the subject have been strongly influenced by the fact that it is intended to be a text-book for the use of students; but with this has gone the purpose of making it a complete engineering treatise in which the theory of the steam machine shall be put into a shape convenient of practical application, and which, on the descriptive side, shall lay a solid foundation for the more special and detailed information which must be gained from experience and from the technical press." The author proposes to present the subject in two volumes, of which this is the first. He takes up in order a general view of the subject, including the steam power plant and a description of typical high-speed engines. Immediately following the description of the engines is a treatise on the elementary thermodynamics of the heat engine. The ideal heat engine is described, and the theory of the steam engine is next taken up. The theory of the steam engine includes a discussion of steam constants and relations, the different states of steam, including a short discussion on superheated steam and the adiabatic behavior of steam. Following this the Carnot cycle is introduced and a comparison of the Carnot cycle with the actual cycle of the steam engine is made and the differences of the two are clearly shown. The limits of the performance of the steam engine with saturated steam are mathematically discussed and a table of limit values for non-condensing and condensing engines is given. The results shown in this table are much better than those which can actually be secured in practice. Following this the indicator diagram is taken up and numerous comparisons are made with the ideal diagram of the engine and the different effects of compression, cut-off, clearance, etc., are discussed. There is also a very thorough treatise on the effects of cylinder condensation; formulæ are derived and tables are given which are both calculated from formulæ and derived from the results of tests on actual engines. The economy of the steam engine is well taken care of and the various effects due to differing constructions are shown. This includes a discussion of compound engines, the effects of steam jackets and of reheating steam in the receivers of compound engines. Diagrams of compound engines are given, and the methods of combining and calculating the steam per horse-power-hour are well shown. Chapter v, comprising seventy pages, is entitled "The Dynamics of Steam," and treats of the steam jet. Numerous curves and tables are given in this connection, and the form and influence of the nozzle and the determination of the adiabatic jet and the effect of conditions beyond the nozzle are shown. The latter part of the chapter deals with the applications of the steam jet, *viz.*, the throttling calorimeter and injector, together with a very short discussion of the steam turbine. Chapter vi discusses the entropy-temperature diagram quite fully and clearly. Chapter vii deals with the mechanics of the engine and takes up forces existing in the different parts of the engine and their various effects. A very thorough discussion of the kinematics of the engine mechanism is given and the discussion is both mathematical and graphical in character. The determination of crank effort from the indicator cards is shown very clearly and the effect of flywheels is well treated. The latter part of the chapter deals with the construction and efficiency of the engine and counterbalancing. There are two appendices to the book, the first consisting of steam tables and tables of other constants. The second appendix is a short discussion of the properties of superheated steam. The author has adopted what seems to us an unfortunate arrangement of the book in several respects, and to have erred in the introduction of new terms to take the place of old and thoroughly established ones. For instance, he speaks of the "steam-force" acting on the piston and the "force-action" of the engine. He also uses the term "stroke line" in place of the generally accepted one "centre line." The arrangement may be criticised in introducing thermodynamics so early in the work (the second chapter) and the interjection of the chapter on the steam jet in the midst of the discussion of the steam engine. This might more properly have been placed more toward the end of the book. In some cases the discussion is rather incomplete. In one place the author states that it is necessary to go through quite a complex analysis in order to determine the forces on the bearings and the stresses on the shaft of the side crank engine. The analysis is not given and the reader is left in doubt as to what method is to be followed in order to determine these stresses. After a formula is derived, very often its application is not shown. On the whole, however, the book is well written, the theoretical discussions in most cases being supplemented by graphical demonstrations and in many cases being illustrated by numerical examples. In our opinion, however, the book would have been improved if the various deductions drawn had been illustrated by examples of constructions in actual use in modern practice. This is particularly true of the discussion on counterbalancing. This discussion is quite long and very thorough, but the application of the various formulæ derived is not given nor are any of the modern systems of counterbalancing spoken of. The book is entirely too heavy for use as a text-book for students whose ideas on the subject are at first necessarily vague, and it would be improved for their use if more profuse illustrations from practice had been given. The book, however, is a good reference book, and is well worth placing on the shelves of the engineer's library. The author proposes to make the second volume a treatise on the performance and design of the engine, and states that he will take up the quantitative and synthetical side of the subject, giving a digested result of the large number of tests now available in works of reference and setting forth methods of engine testing. He also proposes to develop as far as possible a logical scheme of design, especially of the thermodynamic design of the engine. It might be advisable that he should correct in the second volume such errors of omission as have occurred in the first.

Electric Tramways in Lima.

A contract has been entered into between the Ferrocarril Urbana de Lima and the provincial council, substituting the overhead trolley for horse traction on all the street railways of Lima (about sixteen miles in extent). The new system is required to be in operation within two years from the signing of the contract. A new company, representing American and local capital, has succeeded the old one, and the electric and other new material is being ordered from the United States.

CAN A STEAM TURBINE BE STARTED IN AN EMERGENCY QUICKER THAN A RECIPROCATING ENGINE OF THE SAME POWER.[1]

BY A. S. MANN.

If a large steam turbine is cold and at rest how quickly can it be started? Can it be brought up to speed as readily as can a good cross-compound engine that is cold all over?

Most station men would have doubts as to the adaptability of the large turbine, say 1,500 kilowatts or 2,250 horse-power, for emergency work. So much has been written about the sensitiveness of a rotating disc to the changes of temperature and the effects of unequal expansion that it is easy to imagine difficulties in the rapid start. The possibilities of an engine with a sixty-two-inch low pressure cylinder in starting practically cold and coming up to synchronous speed are well understood. A station manager would criticise an engineer who would open his throttle as fast as he dared without wrecking his piping system and let his machine jump into her work. One turn at a time on the throttle is about all that is considered safe, and even then a close watch is kept for groaning valves and cold back bonnets.

Every time the starting valve is moved to increase the steam flow the engine is allowed to take its full increment of speed, due to that particular throttle position, before the supply valve is moved a second time. There are ten large oil cups, and frequently more, that must be opened and adjusted before the machine moves at all, besides whatever oiling is to be done about the air pumps and other auxiliary apparatus.

This question makes itself very prominent when the steam station is operated as an auxiliary to a large source of high-tension power, which is itself in the construction stage and has a large overload capacity of its own to carry, supplying all sorts of apparatus that use electric power, railway, lighting and power circuits simultaneously.

At such a time all sorts of accidents will happen to the high-tension water-driven plant, most of them due to the necessarily temporary character of many of the electrical connections. It takes months before an intricate system of wiring can be thoroughly relied upon, for it takes months before the temporary work of construction can be replaced.

The station at present under consideration is equipped with three Curtis turbine-driven alternators, forty cycles, 10,000 volts, each of 1,500 kilowatts normal capacity. During the summer months the station is operated as an auxiliary to a water-power plant, taking all sudden overloads.

A signal has been arranged, a three-fourths-inch whistle, so that it can be blown instantly should the power fail. A blast of that whistle means—cut in two turbines and bring the third up to speed. The load will be heavy, and all auxiliary apparatus must be in regular operation.

Each turbine has a surface condenser and there are three or four pumps to be started for each pair of turbines; one circulating pump, one combined hot well and feed pump, one pressure pump for the step bearings and one dry air pump, all of which are motor-driven. The exciter is driven by a steam engine and must be started also, for it supplies current to a portion of the auxiliary apparatus.

The boiler room has steam up at all times, supplying a system for manufacturing purposes other than power, and slow fires are kept in enough boilers to make steam needed for the normal load. Forced load means forced fires. The boilers have underfeed stokers, equipped with pressure blast, and will respond quickly to a fifty per cent excess call for steam. The operating force for this is about equivalent to a force for an engine-driven plant. Engineers and oilers, however, are busy about the building on construction work, installing new apparatus and taking such work as their regular occupation when the turbines are not running.

At the sound of the whistle the water tender starts a blower on the extra row of boilers: all blast dampers are opened up and all stokers are allowed to feed at the maximum rate. Each fireman dumps his free ash and bars over his red fire.

The man in charge of the coal and ash conveyer starts the pressure pump for step bearings. One of the turbine men starts the exciter which supplies current to the auxiliaries beside its field current; a second turbine man starts the circulating pump and then his turbine. The hot well pump and the air pump are started by the oiler. These movements take place simultaneously. The force is organized upon the lines that obtain in a fire station; each man has his specific duty, and after performing it looks to see that there is nothing more for him to do. Only a few seconds elapse between starting the first pump and starting the first turbine.

The turbine throttle is opened as fast as an eight-inch steam valve can be opened without endangering the steam piping system. It is not considered advisable to open the throttle valve as fast as a man's strength will permit; but if nothing unusual occurs in the pipe line, sentiment does not spare the turbine.

One electrician attends to the switchboard and telephone. As soon as the machine approaches speed, the synchronizing system is cut in and the main switches are got ready. One and one-half minutes will do all the work here outlined, including the time taken in mustering the crew from various parts of the building, itself not a trivial matter.

Manipulating an engine regulator so that it shall be at a precise speed and at an exact phase relationship from some other machine, not more than 1-1500 part of a second removed from it, is no matter that can be hurried, and one minute is fast time on such work. But the whole thing, phasing-in and all, has been done in two and one-half minutes, including full load on the turbine, which started from a standstill.

This performance has been gone through a great many times, and our record book shows that out of forty-three such calls, ten starts were made in two and one-half minutes, eighteen in three minutes and fifteen in three and one-half minutes.

We have taken the time in a number of instances when all the auxiliaries have been in motion and it only remained to start the turbine and phase it in on the line: the only valves to open in such cases are the throttle and one small oil valve. The two quickest starts have been made in forty-five seconds and seventy seconds, respectively, including phasing-in. Others range between one minute ten seconds and one and one-half minutes. These two quickest starts were made on a turbine which had stood for twenty-four hours with the throttle valve shut tight, though there was a slight leakage past the seat. After the throttle valve is off its seat it is not more than thirty seconds before the turbine is up to speed. A cross-compound reciprocating engine of the four-valve type, 2,250 horse-power capacity, can be brought up to speed from a standstill in five minutes if it is hot all over. This five minutes is to be compared with the seventy seconds required for the similar turbine operation.

A reciprocating engine, which is turning over slowly with the throttle valve just off its seat or with by-pass open and having all its oil cups open and regulated, can be brought up to speed, say seventy-five turns, in two and one-half minutes. This can be compared with the thirty seconds necessary for bringing the turbine up under the same conditions; that is, about one-fifth the time necessary for bringing up the engine.

If the engine is cold all over and has all its oil cups shut tight, all its auxiliaries quiet, fifteen minutes is called a rapid start. Starts have been made under such conditions in twelve minutes. When we start a cold turbine, we open up the valve and let her turn, and in two minutes we are ready to bring her up to speed and she will be at speed in two and one-half minutes, dividing the engine's time by more than four.

[1] Paper presented at the Scranton meeting, June, 1905, of the American Society of Mechanical Engineers.

FUNDAMENTAL FEATURES OF ELECTRIC ELEVATORS.

BY E. R. CARICHOFF.

It is probable that eighty per cent of the elevators installed in the United States every year are electric, and of these practically all are of the drum type; in this type, the elevator car is raised and lowered by winding or unwinding wire ropes on a grooved drum, which is revolved slowly by an electric motor through worm gearing encased in an oil reservoir.

The machine is usually placed at the bottom of the shaft with the drum extending slightly into same, so that the ropes may be led up the sides to sheaves supported on framework overhead and thence to the car which moves between wood or steel guide rails.

The car, consisting of its cage and framework, owing to various conditions of size, load and specifications, may weigh from 1,500 to 3,500 pounds empty; and ordinarily part of its weight is balanced by masses of iron which may be as much as two-thirds the weight of the car.

These counterweights are attached to the end of ropes leading from the car over sheaves at the top of the shaft, and are held securely in a frame which moves in separate guide rails.

Care should be taken that the counterweight frame shall bottom before the car reaches the overhead works, and it must also be provided that the car shall rest on its buffers at the bottom of the shaft before the weights reach the framework overhead. Lack of care on this point and absence of a properly protecting frame for the weights may result in the falling of the weights upon the top of the car.

The weight on the hoisting ropes tends to rotate the drum and produces an end thrust on the worm shaft which is usually taken on ball bearings.

As the car ascends, the unbalanced weight, the live load, and friction load must be overcome by the motor; as the car descends the weight tends to turn the motor in the opposite direction and to make it a dynamo, delivering current back to the source of supply.

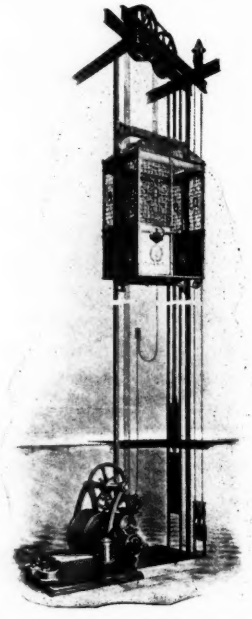
The maximum current that may be generated by a given weight on the drum descending and driving the motor through worm gearing as ordinarily used, is about one-third as much as will be required by the motor to lift the given weight under the same conditions.

With efficient gearing a load of 1,000 pounds can usually be made to start and drive the motor as a generator.

If the motor be supplied with current through a variable resistance on the up-motion and short-circuited through a similar resistance on the down-motion, it is evident that any speeds from zero to maximum can be obtained either up or down.

This gravity method of control is used on the Sprague-Pratt screw machines and corresponds to the method now used for operating hydraulic elevators, but it is not used on drum elevators.

If an unbalanced weight of 1,000 pounds is required to bring the car down, this amount plus the live load in car must be lifted when the car goes up. This requires a larger hoisting machine, a larger motor and a greater maximum current than are necessary when what is known as the overbalanced method is used.



TYPICAL ELECTRIC ELEVATOR.

In the overbalanced system a set of ropes is anchored to the drum and wound in a direction opposite to that of the car ropes, and to the end of these ropes is attached a mass of cast iron called the drum counterweight. As the two sets of ropes move in opposite directions, one set is wound into the grooves left free by the unwinding of the other set.

The drum counterweight usually exceeds the unbalanced weight of the empty car by an amount equal to the average load to be lifted in the car, so that with this load in the car the machine is balanced and the current taken by the motor is the same for both directions of travel.

To get the maximum lifting capacity in the car, the drum counterweight is made to exceed the unbalanced weight of the car by one-half the maximum load.

For example, suppose the motor is capable of driving against a pull of 1,000 pounds on either side of the drum. With an excess counterweight of 1,000 pounds and the car empty, the motor does its maximum duty as the car descends. With 2,000 pounds in the car, the excess of 1,000 pounds is on the other side of the drum, and the motor does its maximum duty as the car ascends. In this way it is possible to take in a car a weight twice as great as the machine would be able to lift if this weight were suspended from a rope around the drum and no counterweights were used.

The gravity system would require the motors to lift 2,000 pounds plus the down driving weight of 1,000 pounds or 3,000 pounds total in one direction.

With an overbalanced system the excess pull is sometimes on one side of the drum and sometimes on the other, as the loads vary, and the thrust on the worm shaft must be taken in both directions by properly constructed thrust bearings.

If the car and its load are just equal to the total counterweight, it is evident that the motor will require in either direction, up or down, the same amount of current, and that this is only what is sufficient to overcome the inertia of the mass and the friction when starting, and while moving to overcome the friction of moving parts in the hoistway, to bend the ropes, and to provide for the electrical and mechanical losses of the hoisting machine. With more load in the car the current going up is increased and the current going down is decreased. With still more load in the car the down current may become zero or the motor may have to act as dynamic brake to prevent excessive speed.

As an extreme illustration the following proposition may be true of a group of efficient machines making long runs and connected to the same source of supply.

Suppose there are six elevators which run two-thirds of the time and stand idle one-third of the time. Assume that two are ascending fully loaded, two descending fully loaded, and two are standing. Under such conditions the two descending cars may generate enough current for one of the machines lifting its full load, and only one machine remains for which it is necessary to supply current. Thus for running conditions the six elevators require a generator of sufficient capacity to supply only one elevator taking its maximum load current. The larger the plant

the nearer the assumed running conditions may be attained.

Owing to the fact that overbalanced drum machines, on account of variations of load, may take or return current in either direction of travel, the motors are best connected through a controller to constant potential mains and run at fixed speeds determined by the shunt winding, the strength of which may be changed to give several speeds ranging from the maximum to one-half of it.

Evidently a machine under such varying conditions of load which takes more or less current or returns more or less current can be regulated and kept within safe limits on a constant potential circuit only by a shunt motor.

It is also evident that the speed of a motor operating as aforesaid can not be regulated by varying the resistances in the armature circuit independently. With no resistance in circuit the speed will not differ much whether the maximum load is being lifted or lowered, and this speed may be called the normal full speed. But with resistance in circuit the speed on the first resistance point is lowest with maximum load up, and the speed on the same point is highest with maximum load down. Under the latter conditions the car shoots down rapidly, at a speed much above normal, and slows up to full normal speed as the resistance is reduced to zero. Therefore devices that pretend to give variable speeds by variation of the armature resistance are deceptive and may be even dangerous.

An elevator starts and stops so frequently that the total energy per day consumed in starting may be 100 per cent or 200 per cent greater than the energy consumed while running.

The friction of worm gearing when starting is much greater than when running, the inertia of the moving parts must be overcome during acceleration, and to meet these conditions the motor must be capable of great starting effort. With a given field-strength the necessary torque may be produced by a large armature current. Half of the energy of this current is wasted in heating the starting resistances. If, however, the field-strength of the motor is doubled, only one-half as much armature current is needed and only one-quarter as much energy is wasted in the starting resistance. Besides, owing to smaller fluctuations of current there is less disturbance produced in the line potential, which is very important under certain circumstances.

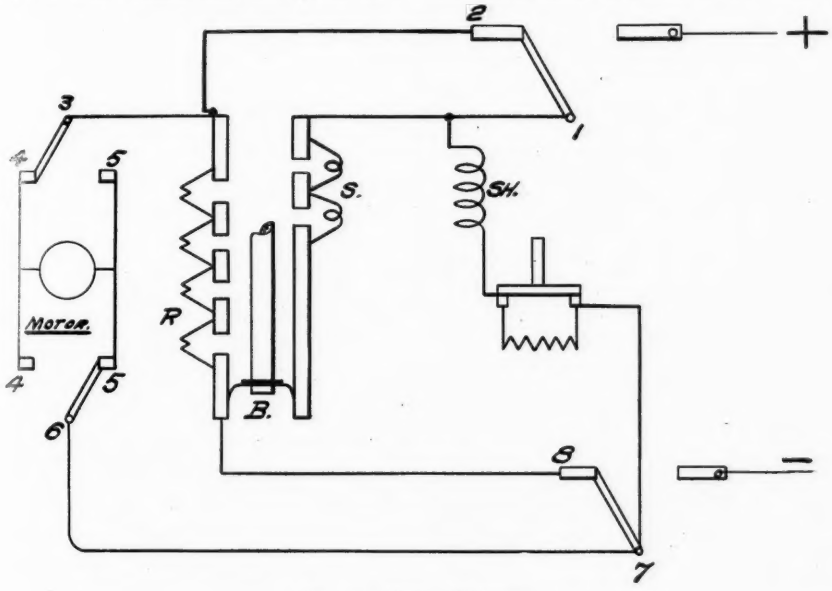


Fig. 2.—Motor Circuits.

Therefore, it is desirable to have for drum elevators a motor with a wide field variation—not less than two to one and more if possible.

The field of the motor should not be kept excited when the elevator is standing on account of the waste of current. If the excitation is begun at the moment of starting through a shunt winding, some seconds may elapse before full strength is attained. In the meantime the armature takes excessive starting current with the attendant losses and disturbances. The best results are obtained by using a strong series field at the moment of starting, and this must be cut out when full speed is attained of the car descending with a heavy load will run away.

Evidently all devices to remove resistance and series field-windings from the circuit must be controlled by the motor as it comes up to full speed, and not by some independently operated device, in order to guard against unsafe speeds and prevent the car from being wrecked at one end or other of its travel.

It has been stated that a full load descending will drive the motor and supply current to the line. Now, in order to stop this load promptly and smoothly, the motor must be turned into an electrodynamic brake to assist the friction brake. Ordinarily the current generated can be returned to the line only by strengthening the shunt field.

This variation should be such as will slow the car to half speed.

To make a full stop, the motor must be disconnected from the line and turned into a self-exciting electrodynamic brake.

Some machines are stopped by the friction brake only, but this method is not satisfactory.

Some have the armature circuit closed through a resistance and depend upon the residual field for generating a braking current.

Some retain a small field current at all times. But this is objectionable on account of the waste of current which may in extreme cases amount to as much as the total current otherwise required.

Another advantage of the self-exciting electrodynamic brake appears when the friction brake fails from any cause.

Indeed, it is well to specify that an elevator for medium and large loads and fast speed shall be able to run and stop and start in either direction, and with any load, with the friction brake held off, as this quality adds an important element of safety.

The movement of the operator's handle in the car should meet with immediate response at the controller, so there will be no delay or sluggishness in starting or stopping.

The time of acceleration may be three seconds or less. The first rush of current should start the machine to prevent loss of time and waste of current in the resistance. Since the machine will attain full speed more quickly under one condition of load then another, it is obvious that the controller should act automatically to meet the varying requirements.

The starting resistances should be removed at a rate proportional to that of acceleration, and, as before stated, the series field must be removed before full speed is attained, or in cases when the machine generates current the series field will act in opposition to the shunt field and excessive speed will result.

With proper attention to the principles given very satisfactory results can be obtained for starting, running and stopping, including changes of speed from full speed to one-half speed, when overbalanced drum elevators are connected to constant potential circuits.

Limit switches should be operated by the machine to slow down before reaching the extremes of travel and to disconnect the motor and convert it to a self-exciting electrodynamic brake and to drop the friction brake at the extremes of travel.

The New Electric Locomotive for the Valtellina Road.

ON OCTOBER 15, 1902, the Southern Italian Railway asked for bids on a four-axle electric locomotive for the Valtellina road, in which gears should not be used. Ganz & Company, having in mind the success of the direct-connected type of locomotive in which the driven axles pass through the hollow shaft of the rotor, and in which the driven wheels are connected to the rotor by links, suggested this type. In the course of the correspondence, the Rete Adriatica proposed that the motors be placed between the pairs of axles, and that the axles be driven by means of connecting rods and coupling rods.

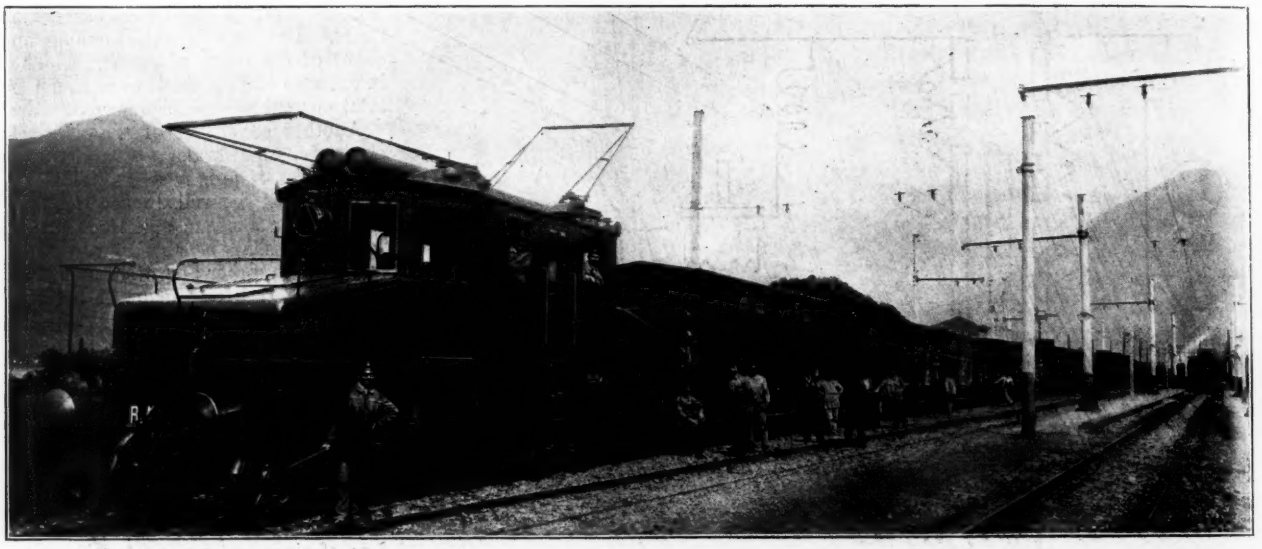
However, before this wish had been expressed, Ganz & Company had already under consideration this method of driving, which, in fact, had been suggested by Herr Carl Gölsdorf, superintendent of construction of the Austrian railway department, who had looked into the Valtellina system, and who objected to the method of driving because of the difficulty of getting at the links, and because the construction of that type was troublesome. The system of driving suggested was worked up by Herr Kandó, with some modifications. Kandó placed the central line of the motors above that of the axles by a distance equal to the length of the driving cranks, and this design was accepted by the Rete Adriatica, which ordered three locomotives of this type from Ganz & Company.

It was required in the specifications that the weight on the leading axles should not be more than ten tons, and on the driving axles, more than fourteen tons. Further, two running speeds were required: one of from thirty to thirty-five kilometres per hour, and one of from sixty to seventy kilometres. At the first, the drawbar pull was not to be less than 6,000 kilogrammes; at the latter, not less than 3,500 kilogrammes, measured at the periphery of the wheels.

The locomotive is carried on two four-wheel and one two-wheel trucks. The four-wheel trucks are at each end of the locomotive and each consists of a pair of driving wheels and a pair of leading or trailing wheels, as the case may be. The four-wheeled trucks are swiveling. This construction has been tried by the Southern Italian Railway in twenty steam locomotives, which have been found to take easily the sharpest curves and run quietly at the highest speeds. The construction of the mechanical part of the locomotives was done at the shops of the Hungarian State Railway in Budapest, and the electrical equipment was made by Kolomann von Kandó at Ganz & Company's factory.

In the view of the completed locomotive, it will be seen that the two motor cranks are connected together by a side bar which drives the crank of the central axle. To this side bar the cranks of the two outer driving wheels are connected by side bars. The crank-pin box of the central axle is allowed vertical play in the motor connecting-rod head because the motors are spring-suspended. The crank-pins of the motors have spherical bearings, on account of the play allowed. All three of the driving wheels are equipped with Westinghouse air-brakes, and the locomotive is provided with a Brüggemann compressed-air track sander. The cab is constructed entirely of sheet iron, and has two side doors and two doors at each end, by means of which communication is had with the train.

The collecting device designed in 1901 for the first locomotive has proved so satisfactory that but slight changes have been made in it. To increase its rigidity, the porcelain insulators supporting the base of the collector have been replaced by cast-iron stands lined with porcelain. The collecting roller consists of two metallic cylinders mounted on the same spindle, but insulated from each other. The carbon contacts have been increased in cross-section on account of the larger size of the locomotive and the heavier currents which must be handled. The collecting device is elevated by means of a dashpot filled with glycerine, into which compressed air is admitted. The pressure of the collector on the wires is controlled by means of an air cylinder containing two pistons. When the locomotive is standing still or moving at the lower velocity, air is admitted to one of these pistons, which is driven forward until it comes up against a stop, thus forcing the collector against the wire with a definite pressure. When the speed of the locomotive is increased, air is admitted automatically to the second piston, which



NEW ELECTRIC LOCOMOTIVE FOR THE VALTELLINA ROAD, WITH TRAIN.

thereby increases the tension on the controlling springs and thus presses the collecting cylinders against the wires with increased force. When the collector is lowered, it automatically opens a knife switch, which disconnects it from the wiring within the car, thus making it safe to handle.

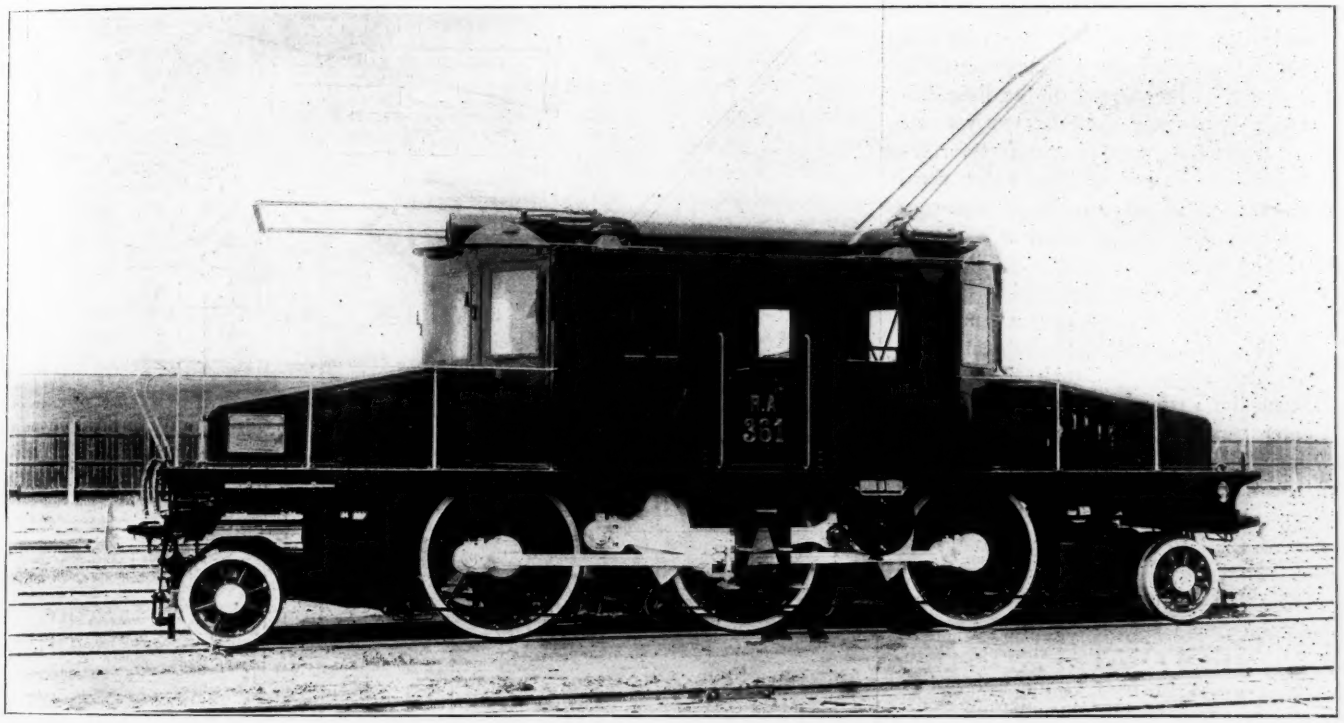
The position of the collectors is controlled by a five-way air cock mounted in the cab. With this handle placed at right angles to the axis of the locomotive, both collectors are down. Throwing it forward through an angle of fifty degrees raises one collector (the locomotive has two, one at each end). Throwing this handle backward through an equal angle raises the other collector. If the handle be thrown through ninety degrees either way, both collectors are raised against the wires.

The locomotive is equipped with two motors. Each is a double machine having high-pressure and low-pressure rotor and stator windings. Some details of these motors were given in the ELECTRICAL REVIEW for February 25, 1905, page 322. Each double motor is contained in one housing. Each stator is supported by four rods with spiral springs between the heads and the stator lugs. The rotor is held central by self-oiling bearings in the stator, but there is no force exerted on these bearings other than that due to the weight of the rotor. For convenience of inspection, the rotor slip rings are supported by a return crank outside of the driving crank. The wires from these rings are led into the rotor through an opening in the return crank, through the hollow crank-pin, back through the driving crank and the hollow shaft. This arrangement, in addition to its convenience for inspection and repairs, enables the entire space within the truck to be devoted to the motor proper, making possible the use of a larger machine than would be the case were the slip rings placed between the rotor bearings. The brushes are of carbon, and are carried on a frame supported from the motor axle. This frame and the slip ring are enclosed in a sheet-iron housing, which is opened along a central line, swinging both ways, leaving free access to the brushes and rings. The windings are carefully insulated, it being required that they be submitted to a testing voltage five times the normal. They were tested at 15,000 volts.

The specifications required that the locomotive should develop 800 horse-power when running at sixty kilometres an hour and that it should develop 1,200 horse-power for one hour, and 1,600 horse-power for a short time. Another requirement was that the locomotive should bring a 400-ton train up to thirty kilometres an hour in fifty-five seconds on a straight track with a grade of not more than 0.1 per cent. It should also bring a 250-ton train from rest to sixty kilometres an hour in 110 seconds on the same grade. The locomotive should drag a train of 250 tons up a two per cent grade, and bring it to forty kilometres per hour. These performances should be obtained with a line voltage of 2,700.

The motor, the rheostats and all the electrical equipment were required to operate without mishap, and without excessive warming, thirty successive times when drawing a 400-ton train, there being a period of two minutes between each application of the power. This test was to be made on a curve with a radius of 180 metres, and a grade of three per cent. An overload of 100 per cent must be supported for 200 seconds without any part breaking down or the temperature rising more than forty degrees centigrade above that of the surrounding air. The temperature rise while supporting an overload of fifty per cent must not be above that just mentioned. It was required that a test should be carried out in the laboratory, in which the motors should be operated at full speed for ten hours without the temperature of the windings or any other part rising more than sixty degrees above that of the surrounding air; and at the conclusion of this test the insulation should be tested with a voltage of 10,000.

The high-potential switches of the previous locomotive had proved satisfactory,



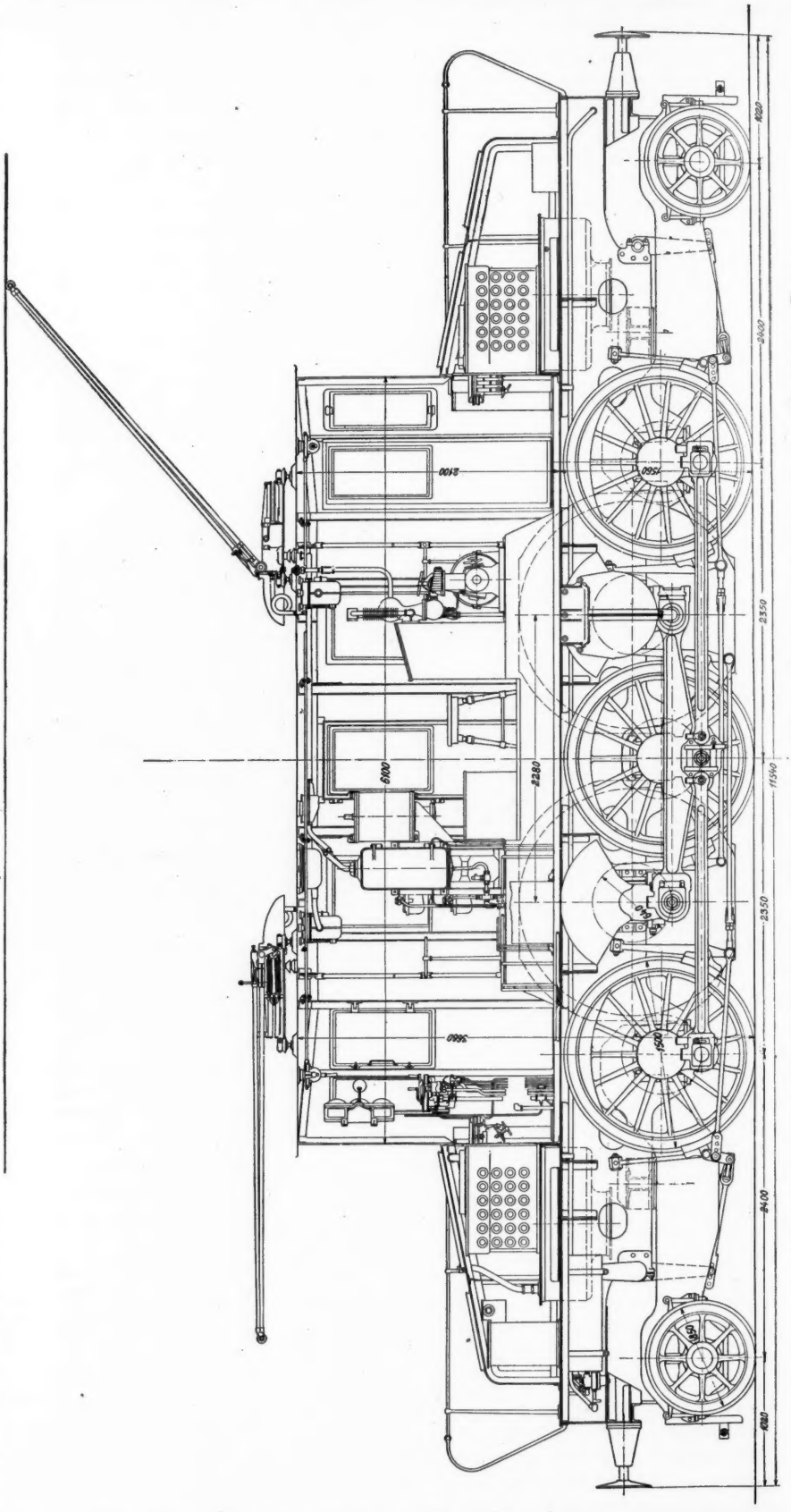
COMPLETED ELECTRIC LOCOMOTIVE FOR THE VALTELLINA ROAD.

so that the same type was adopted for this one. This is a plunger switch consisting of three double-break plunger switches arranged in the form of a hexagon around the operating rod. They are opened or closed by air pressure, and there are, in addition, two small air cylinders which serve to revolve the switch through sixty degrees. This motion which is controlled by a small lever in the cab reverses the direction of rotation of the motors. The low-potential switch is also operated by compressed air. In this the contacts are made by means of brass springs.

The liquid rheostat of the earlier locomotive has so many advantages that this type was adopted for the new machine. However, at the request of the Rete Adriatica, one of the three locomotives was provided with a metallic rheostat for experimental purposes. The water rheostat consists of an outer sheet-iron containing-vessel, within which is a second cylinder open at the bottom. The rheostat plates are suspended within this inner cylinder. The outer cylinder is closed at the top, and compressed air is admitted above the liquid. This forces down the surface of the liquid in the outer vessel so that it rises within the inner and establishes a circuit between the three electrodes. The higher the surface of the liquid within the inner cylinder, the lower the resistance; and when the level liquid has reached a definite point, the rheostat is automatically short-circuited by a metallic switch.

The rate at which the liquid rises within the inner cylinder of the water rheostat is governed by a controlling valve, which is regulated by the current flowing into the motors. The air supply to the rheostat is controlled by a double diaphragm valve, to which air is admitted inside and outside. There is, in addition, an electromagnet which controls the opening of the valve. When the master controller handle is moved through one notch, this valve is opened and air admitted, at a rate depending upon the load, to the water rheostat. The water then rises until a definite position is reached, when it stops. Further movement of the controller handle admits more air, and raises the level of the water again and so on until the rheostat is short-circuited.

The metallic resistance is built of a number of small units suspended so as to allow free circulation of the air. This rheostat is controlled by a series of brushes and contact points, the latter being arranged cylindrically around the spindle on which the brushes are mounted. The overload switch is controlled by an electromagnet which operates a valve in the air pipe. At the time that this switch acts the water is driven out of the inner cylinder of the rheostat, the main circuit is opened.



Outline Drawing, Showing Disposition of Various Apparatus on Electric Locomotive for the Valtellina Road.

The master controller for the two locomotives equipped with water rheostats

has three handles. One controls the direction of motion, one operates the rheostat, and the third changes the motors from cascade to simple connection. When running in this way the low-potential motor is cut out, and the connections from the high-potential motor are short-circuited. The master controller for the metallic rheostat has two handles and a hand wheel, the latter for operating the rheostat switch. The air pump for the older locomotive was objectionable on account of the noise. In the new type this has been overcome by means of a cylindrical slide valve. The compressor operates quietly. It is automatically controlled by means of the pressure in the air tanks.

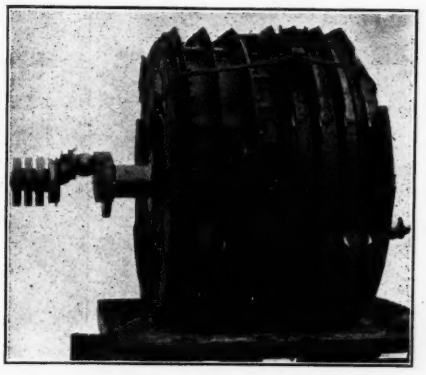
The lightning arrester is formed of a number of small spark-gaps connected in series with the high resistance. The whole is mounted on porcelain and enclosed in a cast-iron box.

In starting the locomotives, if there is no air in the air tanks, a valve in the pipe leading to the collectors is closed, and by means of a small hand pump, air pressure is supplied to the air cylinder of one of the collectors, thereby bringing it in contact with the trolley wire. As soon as this is done, the air-compressor motor may be started, and when the pressure in the tanks is sufficient, the valve may be turned to the normal position.

In general, when the locomotive is to be started, the first operation is to open the air valve, which brings one collector into contact with the overhead wire. Next, the handle controlling the direction of motion must be thrown, and, last, the handle controlling the supply of current to the motors. This is moved around step by step, each step corresponding to a definite height of liquid in the water rheostat. When the last step is reached, the rheostat is short-circuited. The next step is to bring this handle back to the zero position, and to throw the handle which cuts out the cascade connection of the motors. Then the process is repeated.

During the trials, the locomotive dragged a train weighing 286 tons, first up a 1.24 per cent grade, then up a 1.36 per cent grade, and finally up a 1.7 per cent grade, at a velocity of sixty kilometres per hour, developing at this time 1,464 horse-power. While drawing a 250-ton train up a two per cent grade, the drawbar pull was 6,000 kilogrammes, and the tractive effort at the periphery of the wheels, 8,000 kilogrammes—that is to say, the tractive effort was nineteen per cent of the traction load. In one case the tractive effort at the drawbar was 9,000 kilogrammes, which is computed to be equivalent to 12,000 kilogrammes at the periphery of the wheel. This is equivalent to 27.8 per cent of the traction load of the locomotive.

An interesting comparison was made between this locomotive and several high-duty steam locomotives belonging to the Rete Adriatica. These vary in total weight from 92 to 108.55 tons. The electric locomotive complete weighs sixty-two tons. The tractive load of the steam locomotives varies from 42 to 43.5 tons; that of the electric locomotive is forty-two tons. It is computed that, with velocities of thirty-one kilometres per hour, the available drawbar pull of one of the larger steam locomotives will be 350 tons on a one per cent grade, and 152 tons on a two per cent grade. The electric locomotive, on the same grades, will give 460 and 250 tons, respectively. At velocities of sixty-four kilometres per hour, the same steam locomotive gave drawbar pulls of 207 and sixty-eight tons on one and two per cent grades, respectively. The electric locomotive would give 270 and ninety tons under the same conditions. The difference in favor of the electric locomotive, therefore, varies from thirty to sixty-four per cent.



MOTOR FOR ELECTRIC LOCOMOTIVE FOR THE VALTELLINA ROAD.

This locomotive was constructed for hauling passengers and express matter—not for freight. On this account it was necessary to add the two pony trucks to secure quiet and safe running. Had the locomotive been designed for freight, a fourth driven axle would have been supplied in place of the two pony trucks. If the locomotive had been constructed on this plan, the traction load would have been fifty-six tons, and, assuming an adhesion coefficient of twenty per cent, a drawbar pull of 11,000 kilogrammes would be obtained.

COUNTERWEIGHTS FOR LARGE ENGINES.[1]

BY D. S. JACOBUS.

The writer was called upon to investigate the problem of lessening the vibration of the engines at the new power plant at the Manchester street station of the Rhode Island Company, Providence, R. I., and working conjointly with Mr. Fred N. Bushnell, the chief engineer of the company, he recommended that certain counterweights be added in addition to those already on the engines. These counterweights which were exceptionally large were adopted and gave satisfactory results.

In addition to the problem of lessening the vibrations certain electrical problems arose regarding the effect of the counterweights in increasing the variation in angular velocity of alternating-current generators run in parallel with each other. A number of measurements were made to determine the action of the counterweights, both as affecting the vibration of the building and the tendency of the alternating-current generators to break apart when run in parallel.

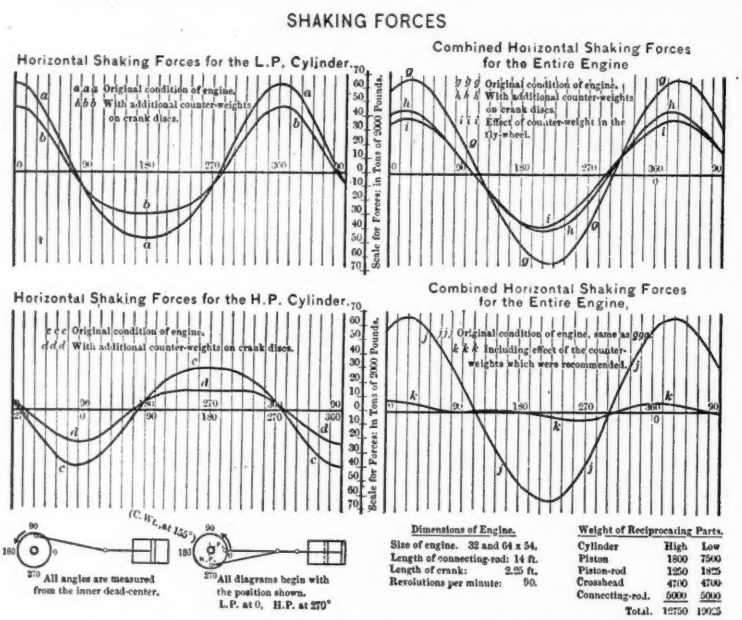
The counterweights were applied to three engines, all of which were of the same cylinder dimensions and had the same weights of reciprocating parts. The engines were built by the Filer & Stowell Company, of Milwaukee, Wis., and were of the horizontal cross-compound type directly connected to electrical generators. Two of the engines, designated as Nos. 1 and 2, were connected to 1,500-kilowatt alternating-current generators, and one, designated as No. 3, to a 1,600-kilowatt direct-current generator.

After inspecting the plant the writer constructed an apparatus on the principle of the seismograph for measuring the amount of vibration. On a second visit to the plant the horizontal shake of the foundation was measured with this instrument with engine No. 3 running, and found to be 0.01 inch at the engine. This may not seem to be a large amount, but as the entire mass of the building foundation shook, the movement of parts of the temporary wooden building was magnified in many places so as to be very evident to the eye. Furthermore the ironwork of the boiler house shook considerably. That the entire mass of the foundation shook could be appreciated by feeling the vibration through the feet and also by measuring the actual amount at different points

[1] Abstract of paper presented at the Scranton meeting, June, 1905, of the American Society of Mechanical Engineers.

with the special apparatus. At a point near the extreme end of the foundation where the No. 1 engine was located the foundation was found to shake 0.008 inch. Measurements made near the top of the chimney, which was then erected to the height of about 175 feet above the ground, showed that the maximum shake with the engine running at its ordinary speed of ninety revolutions per minute was about 0.02 inch. After measuring the vibration of the chimney with the engine running at its ordinary speed the engine was shut down and a marked result took place when its speed fell in harmony with the time of vibration of the chimney. When this occurred, the chimney shook to such an extent that the motion was beyond the range of the special instrument. The total movement of the pointer of the instrument was such that the chimney was shown to move more than one-eighth of an inch.

As the entire plant shook laterally on top of the piles, and as there could be no vertical movement, it appeared evident that the best plan would be to place counterweights on the engines of such sizes that they would diminish the horizontal shaking forces to nearly a minimum irrespective of the vertical shaking forces which might be produced. This would give much larger counterweights than are ordinarily used, but on carefully considering the conditions which existed it was deemed best to adopt them. The counterweights originally on the engines were comparatively small and it was found impossible to place large enough weights on the crank discs to carry out this plan. It was therefore decided to place counterweights on the flywheels in addition to placing as heavy counterweights as possible on the crank discs. A counterweight in the flywheel acts just as efficiently as one placed on the crank disc in eliminating the shaking forces tending to translate the bed of the engine, but with such a counterweight there remain forces which act as couples and tend to shake the engine by rotating it about its centre of mass. The horizontal forces tending to produce translation were, however, the most important in the case under consideration, and these were considered irrespective of the forces tending to produce rotation.


SHAKING FORCES
Horizontal Shaking Forces for the L.P. Cylinder.
a a a Original condition of engine.
b b b With additional counter-weights on crank discs.
Combined Horizontal Shaking Forces for the Entire Engine
g g g Original condition of engine.
h h h With additional counter-weights on crank discs.
i i i Effect of counter-weight in the fly-wheel.
Horizontal Shaking Forces for the H.P. Cylinder.
c c c Original condition of engine.
d d d With additional counter-weights on crank discs.
Combined Horizontal Shaking Forces for the Entire Engine.
j j j Original condition of engine, same as ggg.
k k k Including effect of the counter-weights which were recommended.
Scale for Forces: in Tons of 2000 Pounds.
All angles are measured from the inner dead-center.
All diagrams begin with the position shown. L.P. at 0, H.P. at 270°

Dimensions of Engine.	
Size of engine.	32 and 64 x 54.
Length of connecting-rod:	14 ft.
Length of crank:	2.25 ft.
Revolutions per minute:	90.

Weight of Reciprocating Parts.		
Cylinder	High	Low
Piston	1800	7500
Piston-rod	1250	1825
Crosshead	4700	4700
Connecting-rod.	5000	5000
Total.	12750	19025

FIG. 1.—POSITION OF COUNTERWEIGHTS, AND SHAKING FORCES.

The weight of the counterweights recommended to be added in addition to those already on the No. 3 engine was 4,995 pounds on each of the crank discs and 3,600 pounds in the flywheel, the distance of the centre of gravity of the weights on the crank discs from the centre of the shaft being 2.38 feet and for the weight in the flywheel 7.67 feet. The counterweights originally in each crank disc amounted to a net weight of 1,740 pounds at 2.05 feet.

The position of the flywheel counterweights and the shaking forces with and without the additional counterweights are shown in Fig. 1. Mr. Bushnell designed counterweights for the No. 3 engine to conform with the above sizes. The counterweight is shown in Fig. 2. The counterweights finally placed on the engine were somewhat lighter than called for, but not enough so to produce any great difference in the results.

On starting up the No. 3 engine with the counterweights it ran without appreciable vibration and operated with entire satisfaction.

Counterweights were then placed on engines Nos. 1 and 2, driving the alternating-current generators. As the dimensions of these engines and the weights of the reciprocating parts were the same as for the No. 3 engine, the same size of counterweights was used as for the latter, but those placed in the revolving fields were necessarily of a different form than that

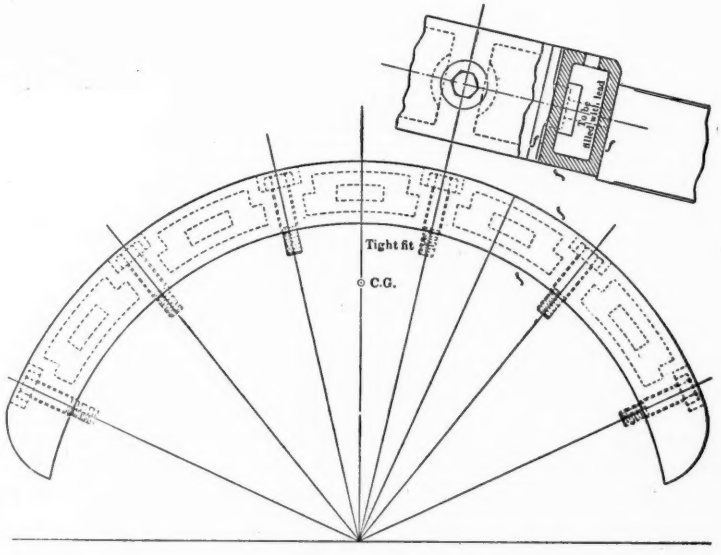


FIG. 2.—COUNTERWEIGHT FOR NO. 3 ENGINE.

employed in the flywheel of the No. 3 engine.

On a third visit to the plant a vertical engine directly connected to a 2,500-kilowatt generator had been erected and was running in addition to the three horizontal engines. It was found that the greatest shaking that could be noticed occurred on the switchboard platform which was anchored to one of the side walls of the building at a point some distance above the floor. When engines Nos. 1 and 2 driving the 1,500-kilowatt alternators were run in parallel with the counterweights opposed they produced but little vibration. When run with the counterweights together there was a greater vibration. The maximum shake occurred when the counterweights of the three engines Nos. 1, 2 and 3 fell together, which would take place about once every fifteen seconds, as the two engines running the alternators ran at about ninety-four revolutions per minute and that driving the direct-current machine at ninety revolutions per minute. The amount that the floor shook was measured and was found to be extremely small and less than 0.002 inch.

The ground was frozen during the above test and it was decided that it would be best to make a final set of observations of the amount of shaking after the frost was entirely out of the ground. Furthermore, some questions arose as to the possible danger of the alternating-current generators breaking out of step when run in parallel with their field counterweights opposed, because when so run, the ammeters attached to the generators swayed considerably, indicating fluctuations in the current.

On looking through the magnets of the revolving fields of one of the alternating-current generators at the revolving field of the other the angular variation back and forth was apparent. This was carefully estimated and under the ordinary conditions of running was found to amount to from about six to eight pole degrees total variation or from about three to four pole degrees for each machine. The amount of this angular variation with the machines running in parallel was about the same irrespective of the position of the counterweights with reference to each other, but when the counterweights were opposed the variations occurred every stroke or about ninety-four times per minute; whereas, when the counterweights were together, or nearly so, the variations occurred at less frequent intervals, the total number of such variations then being from about thirty to forty per minute. As the total displacement of the two fields from their true position, as observed by looking through the magnets of one revolving field at the other, was about the same irrespective of the relative positions of the two counterweights, it follows that this displacement was produced as much through governor action as through any variation in speed during a single stroke.

When the two alternating machines were operating in parallel there was a swaying of the ammeters in the machine circuits. This swaying was, however, of an entirely different frequency from that of the strokes of the engines. The amount of this swaying was noted for different relative positions of the counterweights of the engines. The engines were operating at the time under light loads. The voltmeter reading was also noted and found to be steady in every instance.

It appeared that the fluctuations in the current generated by the two alternating machines had but little influence on their efficiencies and that they were working successfully when connected in parallel.

On a joint visit of Professor Ganz and the writer observations of the angular displacement of the rotating fields and electrical readings were again taken and these observations led Professor Ganz to conclude that there was no apparent danger of the alternators breaking out of step while operating in parallel with the counterweights in any relative position.

Careful measurements were also made at this time of the amount that the engines shook the building. Observations of the angular displacement of the revolving fields when run in parallel bore out in a general way those made on my previous visit.

In order to study more thoroughly the effect of the counterweights in increasing the angular variation, diagrams of crank efforts were laid off corresponding to indicator cards taken from the engines and from these curves of crank effort the angular variation in pole degrees was determined, as shown in Fig. 3. From this figure it may be seen that the variation for a single machine without the addition of the counterweights in the revolving fields would be 1.8 pole degrees, and with the counterweights 3.2 pole degrees. The latter value is the one to be compared with the variations observed by looking through one of the revolving fields and observing the other, and it agrees with the amount which was observed, which varied from three to four pole degrees.

It appears from Fig. 3 that by placing the counterweights in the revolving fields the angular variation during a single stroke is made about twice what it would have been without the counterweights. It, however, appears that the increased angular variation during a single stroke due to employing the counterweights does not introduce any great disadvantage as the alternators can be safely run in parallel at practically the same efficiency as would exist should there be less angular variation.

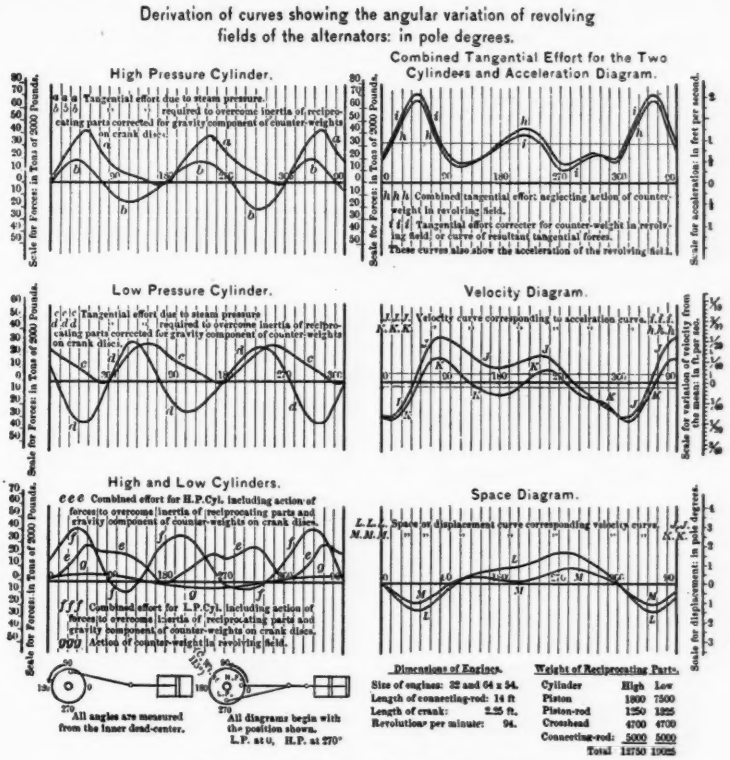

Derivation of curves showing the angular variation of revolving fields of the alternators: in pole degrees.
High Pressure Cylinder.
Combined Tangential Effort for the Two Cylindees and Acceleration Diagram.
Low Pressure Cylinder.
Velocity Diagram.
High and Low Cylinders.
Space Diagram.
All angles are measured from the inner dead-center.
All diagrams begin with the position shown. L.P. at 0, H.P. at 270°
Dimensions of Engines.
Size of engines: 22 and 64 x 54.
Length of connecting-rod: 14 ft
Length of crank: 2.25 ft.
Revolutions per minute: 94.
Weight of Reciprocating Parts.
Cylinder High 1800 Low 7500
Piston 1250 1325
Piston-rod 4700 4700
Crosshead 5000 5000
Connecting-rod: Total 13750 19025

FIG. 3.—CURVES OF CRANK EFFORTS.

Progress in Electric Heating; Electric Power in Factories; District Heating.

AT THE recent convention of the National Electric Light Association three reports were presented, each having a most important bearing upon the economy of central stations, although, in fact, they represent slight departures from the ordinary service of these plants. These reports have been abstracted and follow, supplemented by some further opinions upon these subjects, as brought out during the discussion:

PROGRESS OF ELECTRIC HEATING.

JAMES I. AYER.

With the thought that expressions from the members of the association indicating their experience and methods pursued would be of the most value touching this subject, a set of questions was mailed to all central station members. As may be expected in such cases, all returns were not as complete as could be wished, but many of them, and a number above the average in such cases, show a lively interest in the subject developed by their appreciation of this application of electricity.

The questions seem to have shown the following:

That about one-third have no heating apparatus on their lines, mostly those who have no day service. With those who have, there is a growing interest. Generally sell apparatus at or about cost. About one-half keep such a record as they may from sales, inspection permits, meter records, etc.

That a comparatively small per cent make special rates (twenty-one per cent of those reporting).

With a few, there is a strong impression that the cost for service is high and a serious handicap. With others, that this does not apply to many useful devices, that the introduction of heating goods is important as broadening the field of usefulness of electric service among existing customers, and where rates can be made sufficiently low, material additions in day loads develop.

That the best methods of extending the use is by office exhibits and demonstrations, loaning articles for trial, and personal solicitations.

That there are some material loads of a desirable character added from service to laundries, clothing factories, and other industrial establishments in fifty-two cases; that those customers found the service more satisfactory though in some cases at a higher cost for heat than by other methods.

That the cost of apparatus was a factor in limiting the sale.

The average critic does not always appreciate that an electrically heated tool or device is materially different in its makeup from its fellow of older acquaintance. Aside from producing a device as like as possible to the one it displaces, it must contain a heat generator made to withstand use and abuse in unskilled hands while operating at high temperature, thus calling for great care in design, construction and selection of material. Of the number made compared with articles of like character in common use they are as one to many thousands. The cost of selling is also quite high as compared with articles better known and of wider application, because the field, generally, is restricted to those using electricity who may be persuaded to discard some familiar well-known method and device and buy the new.

Some few stations report failures in efforts to successfully introduce apparatus under conditions where others succeed. This is generally due to the lack of a proper understanding of requirements, methods and apparatus.

While it seems a simple matter to substitute an electric-iron for a gas-iron with equal or better results, and it can generally be done, yet there are kinds of work, kinds of operators, and kinds of irons differing in their individual characteristics which must harmonize when properly combined; all of which means that a thorough acquaintance with the devices you are introducing is essential.

There are favorable conditions where electric lighting is cheaper than gas, unit for unit, where you may not have to include compensating advantages to equal an unfavorable difference in first cost, but you do not find the extension of business possible under such conditions only. On the contrary, you have taught the public that a better thing is worth more, and they know it.

The electric heater in many of its forms comes to you as a compensating advantage to-day to assist in further extending that belief by supplying a service that in some cases can not be obtained by any other means at any price. It meets many household demands better, and usually more cheaply than they can be met by any other means. With the many household, shop and office conveniences available, the electric heater is, except for long continued service, a medium more attractive, convenient, safe and sanitary than any other, and can be operated cheaply enough to furnish an additional reason for taking on or maintaining electric service from a central station.

A. L. SELIG.

Our company has been paying considerable attention to this branch of the business for some time but did not do it systematically. A year ago we possibly had upon our system a dozen flat-irons in residences. About that time we began a campaign for the introduction of a flat-iron as a necessity rather than as a luxury, with the result that we have on the system to-day more than 600 irons consuming possibly seventy-five to ninety cents each, and in our case, being a water power company, adding absolutely nothing to the expense except office expenses we have introduced these irons in laundries, supplying about eight laundries, the installation varying from fifteen to forty irons. We have displaced gas-irons in a town where gas is sold at ninety cents a thousand cubic feet upon a basis of three cents for the electricity. We find that three cents for electricity in an ordinary flat-iron is equivalent to gas at about $1 a thousand, and our experience has taught us that laundries and families or any one else having to do with the particular apparatus will pay from ten to twenty-five per cent more for convenience, quickness and cleanliness in the use of electricity as against ironing by any other method.

We have also—and I regret to say that I have not had time to tabulate this particular investigation—for a year past been experimenting with complete kitchen outfits in one of our towns, selling the current for this particular outfit at four cents per kilowatt-hour, with the distinct understanding that the family was to keep a daily record of what they cooked, how long it took to do it, and to read their meter before and after each piece of work, so that this, I take it, will be a somewhat valuable record for this association to have when the results of the experiment are tabulated. We find that the particular family which was given this advantage for the purpose set forth is satisfied with the result, and will from now on

continue using this apparatus as against gas which it can buy at $1.50 per 1,000. The question was raised by one of the local companies as to the possible utility of using electricity in laundries in ironing. It seems to me that the experience of that company must have been particularly unfortunate, because this question has not been raised with any of the laundries upon our system. We have been supplying some of these laundries now for about a year, and, as stated, they prefer electricity to any other method of doing their work, and in fact two or three of them are now equipping their mangles with electrical devices, cutting out the gas for that particular use, and on a three cents per kilowatt-hour basis.

We have endeavored to introduce electricity for heating space, but find that to be a failure. You can not do that except in isolated instances where persons have a very nice house and are able to pay the bills. In our country the conditions are peculiarly adapted to the use of electricity for heating if it were feasible. We have cool mornings and evenings in the winter, and it is warmer during the day, so that the use of electricity for heating would be limited and the expense necessarily small in comparison with other sections of the country where they have more rigorous climates, but in our section of the country except in isolated cases, such as the residences of wealthy people, the use of electricity for heating space is a failure, and we discourage it rather than encourage it, because we have found in a dozen instances, possibly, that persons who would like to have the convenience of heating space by electricity have bought the apparatus without our knowledge and installed and then simply gone up into the air because of the amount of the bills. Instead of it doing us good it does us harm. It is possible, if you have a long purse you can indulge yourself in the luxury of electric heating, but if you can not afford to pay the bills do not heat with electricity.

We do find that electric irons, electric culinary apparatus, curling irons, and those small things which pay anywhere from twenty-five cents to fifty cents or a dollar a month to the central station company can be successfully introduced, but can only be pushed by personal solicitation. We engaged a woman who knew of the advantage of the apparatus, who said to us that she would go upon our system, and we are in a city where there are three competing companies, but that she would confine her work to our lines and would sell these irons for us upon a margin if we would let her have them at cost. We did that gladly and she introduced a great number of these irons for us. We let a lot of them out on a thirty-day trial, and out of the hundreds put out sixty-five per cent stuck, and we believe this year our revenue from this sort of service will be increased not less than $10,000 a year without any appreciable expense to us.

JAMES I. AYER.

In connection with laundry work I will say that there are upward of 300 laundries equipped with electric heaters throughout the country. The laundry installations are growing. The question of the use of air heaters is like the question of the use of cooking apparatus on lighting rates. It is not practicable at the average lighting rates to do general cooking and take over all of it. It is not practicable to do cooking at a much higher rate than three cents, where you are going to do all the cooking; but you can utilize in your kitchen a broiler, waffle iron, coffee pot for the dinner table, a chafing-dish, and similar things used from once a week to once a day, without any appreciable additional cost in the month's bill. I know of three cases, of which we have obtained data, where all the broiling in a family of from four to six persons and the coffee making, together with the incidental use of an occasional stove for toasting and doing little things in the evening, the use of the chafing-dish, the use of the family flat-iron, not for the laundry, but use about the house, the pressing a woman does in dressmaking and little things which do not come under the regular laundry work and in each of these three cases in no instance has the increase in the bill averaged more than $1.25 per month or about twenty per cent increase over the lighting bill where this free use of current was made. When you talk of a broiler you are talking of a device using ten or fifteen amperes, 110 volts, two hundred or three hundred watts, which has been in service about twenty minutes; a coffee machine taking two hundred or three hundred watts for twenty minutes. The incidental use of the chafing-dish is not large. The household flat-iron is used in many houses from five to ten or fifteen minutes at a time at the most, for pressing a seam, or some similar service, and it is not necessary to keep it in service more than ten minutes at a time. While the iron may use four hundred or five hundred watts, the total watt-hours in a day is small during which it is required, and the device is cheap and convenient.

In regard to radiators, there is a field for radiators in dwellings which is very large and becoming more so, and that is the use of radiators in the bathroom in the winter—there is a demand for something to take the chill off the bathroom. It takes a 2,000-watt heater to be effective, and fifteen or twenty minutes to accomplish the desired result. When I give that rating of heater, I am speaking of the average bathroom, and the time taken to heat the bathroom includes the average bathroom, and the amount of heat required to warm a room within the limit of time a man is willing to wait before the furnace in the house has got in its work. In practice we have found in the seashore summer homes and in the winter residences that the radiator is a great success. It may cost seven, eight or ten cents, or possibly twelve cents, depending on the rates for the heat required to take a morning bath. Take that in the case of a man who wants the convenience and the cost is low. It is a field which is growing larger every day, and a thoroughly practicable one. The experience of one of our members who installed an electric heater was unique. He was very much delighted with the heater, but he took a bath one morning just as he was about to go away on a two weeks' trip, and when he came back his bill was $96. He was the president of the company, which was an element in the case that made the situation a little easier to bear.

In all that I have said to-day I have tried to point out the idea of the members using the electric heating appliances of the smaller class to strengthen their hold upon their customers. The thing a person finds useful and valuable is the thing you want to put into his hands. If a person gets a water boiler or a little device of any sort, a flat-iron or any of the heating appliances in his home, you have not only increased the usefulness of your current supply, but you are doing missionary work in educating your customers to a further use of electric current. But to advocate that you will go home and make attempts to make a wholesale application of electric heating is not my intention. In the first place, when you come to installing kitchen outfits, when you go into the larger application of these things, you must be informed about the goods you are putting out; you must know the goods themselves and have had experience with them. This is not a thing which you will learn in a day. It is not difficult to learn about the simple things, but nevertheless it is the simple things you must master by closer acquaintance with them before you will be in a position to put them out to the general public who have no appreciа-

tion of the principles involved in heating methods. They do not appreciate the value of intimate contact with these appliances and the host of little lessons to be learned.

As to the cost of general cooking, you can safely figure that the cost for electricity has got to be down to three cents per kilowatt to be on a par with good $1 gas. The calorific value of gas varies some, the efficiency of the devices in which it is used varies, and all that, but the record from a large mass of data shows that to be an average condition you can count on. No two families use the same kind of gas stove; there is not the same character of living nor the same number of people, and there will be a variation in the bills. The factor of personal equation comes in, and the methods of handling the apparatus. But there is a law of averages and the statement it will take a kilowatt per day per meal per person for three meals to do all the cooking required for a family will be found to be a safe average for a family of three persons and up; it will not vary much with the increased size of the family; about 3.33 watts per meal per day per person. That involves a regular dinner cooked by a servant in the regular way, not in the hands of experts or people who are checking.

The question of heating air is impracticable from the point of view for cost for large quantities, not for small heating where people are doing electric cooking, as they are in many places where they shut off their range. Where people want hot water they can secure an ordinary type of kitchen boiler varying in capacity from thirty-five to forty gallons with a heater of maximum capacity not exceeding 2,500 watts, they can install the electric heater and use it with good success. What is required for the bath in a small way is not a very heavy expense. The boilers should be located and are frequently put in the water main right in series with the kitchen boiler. In other cases, where they are wanted for the bath alone, a five-gallon or ten-gallon boiler is put on the water main in the boiler. An hour's run, at about two kilowatts, will give a sufficient quantity of hot water for an ordinary bath; about thirty gallons. It is a question of rates, as to whether you want to encourage that practice or not. Where you sell current at five cents, people will be glad to pay ten cents for a bath. Where you attempt to heat water in the kitchen and utilize it as hot water is usually used, for dish-washing, etc., with the large incidental waste, it is impracticable, although some people do use these things in that way. We do not recommend it, but we supply the demand where people are interested enough to do it, and under such conditions we usually have good results. We have no complaints from central stations where they have bought articles of that sort, and there are a dozen stations which I have in mind which have installed hot-water boilers in their stations for cleaning lamp globes, the men's dinner pails, and that sort of thing, and where a careful check has been made it has been found that the average supply of current to the boiler is about 500 watts.

PURCHASED ELECTRIC POWER IN FACTORIES.

E. W. LLOYD.

The subject "Purchased Electric Power in Factories" has received considerable attention from engineers in the past few years, and I believe it is now the concensus of opinion that the use of motors for driving machinery in factories is the most economical, practical and flexible known to date. The question as to whether the current for driving these motors can best be furnished from an isolated plant in the factory or from the lines of the central station company furnishing power in the district, depends upon the rate per kilowatt-hour charged by the company when the installation conditions are the same. I believe the time is near at hand when the greater part of factory power loads will be furnished from central station service, as such great improvements have been made in central station generating apparatus in the past few years that the selling price of electric current for power purposes has been reduced to the point where we can successfully compete with private plants.

I do not think central station managers have much difficulty in obtaining power customers up to ten or fifteen horse-power, as the cost of running motors of this size is generally below the cost of running a steam engine or other prime mover now on the market, particularly when all of the items that go to make up the operating cost are taken in consideration. Even though the cost of furnishing current to small consumers were a trifle greater from the central station service, we should have very little difficulty in obtaining this class of business, as a factory owner would rather not be bothered with the power question and prefers to pay a little more if he is satisfied he will have no trouble. It is, therefore, with the large installations of motors in factories that run from central station service that this paper will treat.

The question as to whether a factory will run from central station service or whether it will generate current from its own plant is not always decided by the rate per kilowatt-hour which the central station company proposes to charge for the current. To any one who has had experience with installations of motors driving machinery, where one large motor was used, it is known that no economy can be obtained over engine drive with profitable rates for central station service. It may be possible with the use of a few motors in a large plant running fifteen to twenty-four hours a day with a low rate per kilowatt-hour, that central station power can compete with engine drive; but the average plant does not run more than ten hours a day, and, therefore, the rates of a central station company doing a profitable business can not compete successfully with these conditions. It is, therefore, necessary to consider other sides of the factory power subject than merely the question of price per kilowatt-hour.

The most important fact that has been developed to-day in connection with this subject is that the proper motor installation has everything to do with the economical furnishing of electric current from central station service. I think central station managers will agree that in a great many cases where factory power was lost to them the fault lay in the fact that the motor installation eliminated none of the wastes in the plant that were in evidence when it was driven from an engine. A great many cases of this kind have come to my notice, and I am fully convinced of the truth of these statements. While it is no doubt difficult to convince factory managers that the installation of a great many motors is the only economical method of driving, this is being accomplished by a number of companies, and it is becoming less difficult each day to demonstrate the efficiency of individual or good group-drive installations of motors. The elimination of all friction loads in a factory makes a wonderful difference in the kilowatt-hour consumption. I believe the time is coming when machinery of almost every description will be equipped with electric motors before it is put into service. It is a well-known fact that the efficiency, flexibility and output of a tool are materially increased with the use of individual motors. While it is true that the installation of individual motors increases the connected horse-power load in a given factory over and above what it would be should group-drive installation be made, it is also true that the current consumption is considerably

less on the individual motor installation. There are engineers throughout the country who advocate individual motor installation, but I believe the subject has not received the proper consideration from all central station companies, and the sooner it is brought forcibly to their attention that this type of installation will do more to increase their power load than any other one thing, the more universal the practice will become. The selling by some companies of electric current at very low rates, even to the extent of losing money on this current, is not necessary with proper motor installations. Extremely low prices for electric current in some localities are detrimental to the station business in others, and I do not think they are necessary if the proper attention is given to the engineering features in obtaining power business.

The agent sent out by the central station company to obtain large business must have some training before he is competent to get business. It is necessary to make a special study of factory conditions. Starting in the engine room he must understand the coal consumption of different types of boilers and the steam consumption of the different types of engines. While it is very likely he can obtain from most factory managers the coal consumption in the plant, it is very necessary that the agent know whether this coal consumption is correct or whether it is abnormal considering the engine and boiler installation. If the coal consumption per horsepower be high it is a point in favor of central station service. It must be taken into consideration that in a great many plants they do not always keep a correct record of the plant costs, and, in view of this fact, it is necessary to know what items go to make up these costs. The mere costs of fuel and labor are not by any means all of these costs.

One of the most difficult propositions an agent will meet is where a factory is equipped with fairly efficient engines and where there are a great number of machines in operation. The factory manager objects seriously to spending a great deal of money on small motors for the operation of his plant, and it is often necessary to guarantee results from such an installation for a short period in order to convince him that you are accurate in your estimate of the kilowatt-hours per month.

Factory managers are appreciating more and more every day the advantages of electric drive, and it is not nearly so hard a job to induce them to-day to change over to motor drive as it was a few years ago when there were comparatively few large plants in the country equipped in this way.

In connection with motor installations in new factories, it should be borne in mind that there will be a considerable saving in the first cost of the building and equipment by the removal of heavy line shafting. The cost of belts and pulleys and their maintenance is also eliminated to a large extent by the use of motors.

When endeavoring to convince a factory owner that he should accept central station service, his attention should be called to the fact that there are other reasons besides saving in cost of current that should convince him that this service is to his advantage—such as the elimination of smoking chimneys; inability to get coal should there be strikes; breakdown of the transmission shafting, stopping the entire plant; breakdowns of engines or boilers; the liability of accidents in the plant from explosions or other accidents; cleanliness; the absence of belts, vibration and heat; and, as before stated, the increased efficiency, flexibility and economical operating of the machines throughout the factory operated by motors. The output of a tool can be materially increased by such installations, and, therefore, the investment in tools decreased for a given output. Furthermore, there is the reliability of service from the central station at any time during the twenty-four hours. Should he have a particular contract where it is necessary to run a few machines in order to turn out goods, he can run this part of his factory very economically, it being only necessary to use such motors as are direct-connected to the machines that are required to do such work. There is also the fact that should his business increase it is only necessary to expend a small amount of money in order to increase the capacity of his power plant, instead of buying a new generating unit or of running a very large engine on an uneconomical load for a number of years.

In looking over the information sent by the different companies you will notice that there are some lines of business to which the central station furnished little or no power. As the selling of power from central station service is still in its infancy, this is not surprising; in fact, it is more surprising that the central station companies have obtained such large power loads in so few years. Experience in some lines would indicate that it will be necessary to give better rates on these classes of business than on others, in order to increase the central station loads in that direction. On machinery such as large blowers, refrigerating machinery, air-compressors, running ten hours or more, or any other machines that have a very high average load during their period of operation, the price per kilowatt-hour must necessarily be less than for machines such as punches, lathes or other tools, where, no matter how continuously they are operated, the average load is only a small part of the maximum load.

A. C. DUNHAM.

We have now installed and are operating a little over 5,000 horse-power in motors. Our lowest price for 1,700 kilowatt is $1.65 per kilowatt-hour. That is based on a large manufacturing concern, of which we have a great many. The price was made up after an examination of the books of a large drop-forging concern. The books were open to us and we went through them carefully and discovered the average cost for three years. Our largest user of power is Pratt & Whitney. We sell them 650 horse-power. They asked me to make this price and brought down a ream of papers and showed what it cost to make this power in three large establishments where they ran generators by steam and had motors scattered all over the factory. You must compete with that. You can not base your ideas on motors simply, because they pay for the motors and can put in steam engines direct-connected to the generator to make their own current as well as the central station. There is an element comes in there which will be overlooked unless you have put out a very large amount of power for a small place. We find on the switchboard of the 5,000 horse-power in motors installed we delivered from the switchboard about forty per cent; that is to say, the averages of the efficient power all through the town will run a good deal less than the total input of motors. I think that is where the profit comes in. You figure you are selling so much horsepower, and you are not delivering it. The price is based on nine hours' use, and we escape the peak, except for two months in the year. They stop at five o'clock all the year round. Perhaps for two months there is a small peak which we supply by storage battery.

L. W. EMERICK.

Information is desired of any cases where a proposition has been made involving power furnished a concern whose by-products were available in the way of fuel, such as sawdust shavings, buckwheat shucks, or anything of a similar nature. I had one case, that of a buckwheat mill, turning out large quantities of buckwheat shucks, ordinarily used for fuel and

possessing considerable value in that respect. This particular plant runs for about five months in the year, twenty-four hours a day, making enough shucks to furnish the fuel they require. In order to become acquainted with the facts of this and similar cases I spent a couple of days looking up their plants and find that contrary to my first belief the shucks have a decided fuel value. The proposition was a difficult one to handle, as the plant requires some steam for drying purposes as well as heating. After considerable time spent on the proposition we finally worked out a plan whereby if we allowed a rate that appeared to them quite low and, in fact, was low for power to be furnished during eighteen hours, and thereby relieving us from a load of this kind during the peak, and enabling us to control the demand in a way that would satisfy both the customer and the central station conditions.

JOHN F. GILCHRIST.

I will emphasize one sentence which Mr. Lloyd brings up, which I think is a point of great importance with all the companies and that is discountenancing the practice of attempting, without sufficient investigation, to get business by cutting rates, and Mr. Lloyd has shown quite conclusively that the average plant now running from steam engines is properly designed, and by good engineering a great economy can be obtained which can be laid to the credit of the electrical installation. It undoubtedly might be obtained by a redesigning of his steam plant.

I can cite one case, which will give an answer to the question raised by Mr. Emerick. We had the case of a concern which manufactured coffins. They used probably 150 to 175 horse-power. They had operated by steam and had a great deal of hardwood sawdust, shavings and chips, which is not as marketable as the soft-wood shavings, as refuse, which they used for generating steam. We worked on them a long time and the lowest rate we wanted to quote was 4.5 cents per kilowatt-hour. They showed us they could not afford to pay more than 2.5 to three cents per kilowatt-hour. We argued that their average load would be nothing like what they thought it would and that their bills instead of being $250 a month, at 2.75 to three would probably not be over $150 to $175 at 4.5 cents per kilowatt. I finally got them to put in a kiln for drying their lumber, which was done by using the refuse, and then by making them a maximum guarantee for a period of one year of $2 per horse-power installed, with the definite understanding that it was merely a test and that we would not consider such a proposition for more than one year, and that at the end of the year they must go on the meter rate. The results were favorable and they have never had a bill over $175.

REPORT OF COMMITTEE ON DISTRICT HEATING.

W. H. BLOOD, JR., CHAIRMAN, R. S. WALLACE, C. B. MAUNSELL.

As a general proposition, cities of 20,000 population or over have well defined and thickly settled business centres. This is also sometimes true of cities down to 10,000 population. It is evident that the farther away from the plant the customer is located, the poorer will be the service he receives; if steam is supplied the more moisture will it contain, and if hot water is used the lower will be its temperature when it reaches him.

The number of customers and the quantity of heat that they require, or, in other words, the density of the load, is an important factor which must be taken into consideration. As a general rule, the commercial business is the better in every way, since not only is the income derived from it greater per foot of main, but the amount of heat required per cubic foot of space so used is less proportionately, for the reasons that the buildings are not used at night, are less exposed, and usually have thick masonry walls. The service runs for commercial business are almost invariably shorter than those for residences, and in many cases one such service can be arranged to serve two or more customers.

Changes in the population of his city should receive the manager's closest scrutiny, for if the city is growing rapidly it is essential at least to keep pace with its growing demands. In a city not supplied with district heat, there comes a time when the undertaking of this branch of the business must be considered by the electric light company. If the opportunity is allowed to pass, it may be taken up by some new company as an entering wedge to serving the public, and perhaps greatly to the disadvantage of the older company.

A company just entering the heating field should be able, without much difficulty, to secure contracts for most of the buildings that are already piped. If exhaust (or live) steam is to be used, this does not entail any additional expense to the customer in changes to his installation; that is, if his building is piped for either hot water or for steam it can be handled from a district steam heating plant. If, however, hot water is to be distributed, an installation arranged for steam will require remodeling before it can be so served.

An element of extreme importance in this consideration is the relation of the cost of steam coal to that of domestic coal. In cities where steam coal costs from one dollar to two dollars and where domestic coal runs from four dollars to nine dollars, the company has much in its favor, and should be able to make rates that are at once attractive to the public and profitable to itself.

The length of the season is a factor to be considered, especially when heat is furnished on any flat rate system, *i. e.*, per square foot of radiating surface per season, per cubic foot contents per season, etc. When on a meter basis, however, the length of the season is of much less importance. It is well to avoid, in general, the making of contracts requiring heat during the summer months.

If water for condensing is not available, the argument for district heating is strengthened. Very many plants have short and sharp winter peak loads; and it would seem that under such conditions their managers might be warranted in installing some inexpensive, simple, non-condensing engines, the exhaust from which would be well utilized for heating purposes; or it might even prove to be best, under proper conditions of load and fuel costs, to install condensing apparatus which would run during the summer, but which in the heating season would be cut out, the exhaust steam being then utilized on the heating system.

The returns that we get from steam heating plants indicate that it is safe to figure for ordinary conditions about 0.20 pound of water per hour per square foot of radiation (varying from 0.05 to 0.50). As all the consumers are not using the steam at the same time, particularly if on a meter basis, the load-factor should be no more neglected than in the lighting business. Naturally, with the heating business this is higher; and if we use the figure of eighty-five per cent we shall probably be on the safe side.

Together with the above must be figured the interest charges on the total underground installation and that portion of the central station plant which is used for heating purposes; and lastly—depreciation—an item that is often neglected but which should nevertheless be estimated. From the best evidence at hand the last item seems to be about five per cent per annum on the total cost of the investment.

It is a well-recognized fact that a district heating system has often enabled a

company to secure contracts for light and power which it would not otherwise have obtained. These then produce an increase in load which in turn supplies more exhaust steam to sell for heat.

In many cases live steam has to be supplied at certain times in order to give good service. Where this condition exists and the demand on the live steam increases, it soon becomes necessary to set aside or to install a boiler solely for this purpose. The chances are that the plant is selling live steam on an exhaust steam basis, and it soon becomes evident, if the question is investigated, that there is no profit in the business.

So long as the demand does not exceed the supply of exhaust steam, but follows it closely, and the rates are kept up, the plant is in a fair way to make money, but any plant that undertakes to sell live steam on an exhaust steam basis is doomed to failure.

It is essential that rates be carefully fixed at the beginning of operations and that the cost of generating and distributing heat, plus proper investment, depreciation and dividend charges, be the basis of such rates. While it may be possible to compare with the daily and monthly load curves of the central station a hypothetical curve representing the amount of heat required by buildings of given dimensions, and thus estimate how much of the available exhaust steam can be utilized and how much live steam must be added, the result is at best an approximation. The only safe and reasonable rate is that based on the cost of supplying heat direct from the coal pile, or, in other words, on a live steam basis. Any exhaust available with rates thus fixed can, of course, be used to advantage.

If the heating business is to stand upon its own merits, it is unwise to go into it on any other basis than that indicated above. If, however, it is the intention to supply heat where so doing secures good consumers of electricity and for the express purpose of getting such consumers, it brings up entirely different considerations. It behooves the careful manager to direct the growth of business on the heating system in the direction that will bring the greatest number of good consumers of electricity, and to this end all extensions of mains should be carefully considered, remembering that the supply of heat is limited.

It is advisable to limit the service connections made in street mains to the fewest possible, making extensions, wherever practicable, from service pipes in adjacent buildings, with due regard, however, for the capacity of the service from which the extension is made. For this and other reasons, it is essential that all service pipes, extensions of same and service valves should be laid and owned by the central station.

Theoretically, a meter rate is the only equitable method of charging, but practically it may be found that a flat rate will answer the purpose fully as well.

Too much heat is not only possible but is nearly as bad as too little, and the consumer naturally takes pains to shut off the steam when the room begins to be uncomfortable. This would seem to form a strong argument in favor of a flat rate system.

If the flat rate is established, it is necessary to decide whether the rate shall be based on the square feet of radiation installed, or on the cubic feet of space, or on the equivalent cubic feet of space heated, which latter case takes into consideration windows, doors, masonry walls, etc.

A summary of the information collected shows that the steam consumption is greatest where the average temperature is lowest and that this is an important factor to be considered in arriving at the rate to charge; that the kind of service makes very little difference in the steam consumption, although residences seem to have a greater condensation per cubic foot of contents and a less per square foot of radiation than either stores or offices; that the results are near enough to justify the establishment of a flat rate, this being on the assumption that customers will use practically the same amount of steam whether on a flat or meter rate; and, finally, that if a meter rate is established a corresponding flat rate would vary according to the length of the season and average temperature.

C. R. MAUNSELL.

In my town we have had quite a little agitation on the point of the variation in rates, some customers being charged by meter and some by flat rate. They naturally ask, why do you take some customers on the meter rate, and some customers on the flat rate. The reason we place the majority of customers on the meter basis is because those installations would use an excessive amount of steam if left on the flat rate. We have one instance where there is a store on the first floor, a restaurant in the rear of the store, and the upper floors used for offices. The owner of the building is determined he will not use steam taken from our company, and he allows the attendants to get along the best way they can. It is not good policy, but it exists, and it brought about this very point. The occupant of the store insisted upon having a flat rate. It was necessary to supply steam through a long main line, together with the necessary branches before we could get steam into this store, and we refused to do it on the flat rate, and insisted on putting it in on a meter basis. The man carried the point to the city council that we were discriminating in rates and created an agitation. It seems to me the matter narrows down to a question of whether we are going to do the steam-heating business on a flat rate or a meter basis. Every man in the central station business will get up against the variation in rates, and if we do not meet it in the best way for our interests, which I believe to be the meter basis, we have to go out of the steam-heating business.

A great many companies throughout the country have gone into the heating business expecting that it was all velvet, and in figuring on the selling of exhaust steam calculated how much the investment would be and how much return they must secure to pay interest and depreciation. If they would figure absolutely on a live steam basis and sell it that way, there is no question but it would be a success, as every plant so operated is making a success of it.

The question of the control of installation is one of most vital importance, if you attempt to do any business on a flat rate. There is nothing that will bring home to a man so forcibly the extravagance of leaving the doors and windows open than a monthly reminder in the form of a bill. It is the same way in regard to lighting on a flat rate. The customer is careless in the use of the steam and allows the doors and windows to be open and gives you a considerable lower percentage of profit on his business than if he were paying on the meter basis.

JAMES E. PYLE.

I have found that steam-heating systems, as a rule, whether fed from the street mains or from boilers, are very unsatisfactory as a general thing to the customer and to those heating. I have found that the district steam company system of supplying steam heat to a building requires very much less radiation than is ordinarily used from an ordinary steam boiler, and that the chief trouble with the whole thing is that it is not under control, the same with the boilers in the cellar. We have introduced the system of control in our steam-heating main which is applicable to boilers just as well, and it is of interest to every man who has a home to heat or store to heat to buy steam whether by

boiler or from the mains in the street. We come in from the street and rise up to the highest point in the basement, and go through a reducing valve and reduce the pressure to five ounces and hold it there. We raise the pipe to the highest point and drain it by gravity to where we want the pipes to leave the building. Each radiator is equipped with a half-inch pipe with an indicating valve at the top of the radiator. We use a water radiator only, and figure on twenty per cent more radiation than the ordinary single pipe system by using the value at the top of the radiator with an index on it. That will show whether there is enough steam being admitted to heat one-quarter, one-half, or three-quarters of the radiator. We can admit enough steam to give the required amount of radiation for any kind of weather. In that way we heat the top of the radiator to the first notch only. The water is condensed and goes to the bottom of the radiator which is chilled and before it leaves the radiator all heat is used in the apartment being heated. The pipe from the radiator is connected to a small pipe in the basement which has no connection with the steam pipe whatever, except through a water-loop that may drain the steam pipe. From there it is conducted to coils for the purpose of cooling water condensed in the piping system only. From there it goes to the meter. This gives the customer the advantage of regulating the amount of steam in all the rooms independent of the fact as to whether the weather is very cold or moderate; he can have what steam he wants. The principal waste in steam heating is during mild weather, when large radiation is not required, which is overcome by this method; and we have found that our system operating on this plan is giving very much better satisfaction than the system operated on the single pipe plan and we are free to say that our customers' bills on this plan are at least thirty per cent lower on the single pipe system. Our system is almost entirely equipped with this kind of piping in every place. The only dissatisfied customers we have are those using the single pipe systems. The others like the service. They are heating on a basis of forty per cent cheaper than they could heat with coal at six dollars per ton. Some report a saving of thirty-three per cent on their coal bills. This system permits any company in this business to charge a rate proportionally higher and still give satisfaction which is an important point to all steam-heating plants.

CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

MANHATTAN BEACH, L. I., N. Y., JUNE 14, 15, 16.

The American Railway Master Mechanics' Association held its thirty-eighth annual convention at the Oriental Hotel, Manhattan Beach, L. I., from June 14 to June 16, inclusive. Two hundred and sixty-five members of the association registered and attended the business sessions, which were held in the ballroom of the Oriental Hotel.

The following papers were presented at the different sessions: "The Proper Loading of Locomotives." Discussion of report on "Locomotive Tests of the Pennsylvania Railroad Company at St. Louis Exposition." Topical discussions: 1. "The Best-Known Dimensions for Water Space Around Fire Box to Produce a Minimum Consumption of Fuel; and Replacement of Fire-Box Sheets and Reasons for Same." 2. "Locomotive Stokers." "The Value of Superheated Steam for Locomotive Work." "Locomotive Driving and Truck Axles and Locomotive Forgings." "Shrinkage Allowance for Tires." "Motive Power Terminals." "The Technical Education of Railroad Employés: the Men of the Future." Topical discussions on "High-Speed Steel" and "Staybolts." Discussion of reports on "Water Softening for Locomotive Use," "Time Service of Locomotives," and "Shop Layouts." "(A) Proper Lubrication of Valves when Drifting; (B) Relative Setting for Piston and Slide Valves." Topical discussions: "Relief and Bypass Valves for Locomotives," and "Are Engines with Self-Cleaning Front Ends Satisfactory?" All these papers were copiously discussed.

At the conclusion of the sessions the election of officers was held. It resulted as follows:

President, H. F. Ball, superintendent motive power, Lake Shore & Michigan Southern Railroad.

First vice-president, J. F. Deems, superintendent motive power, Vanderbilt lines.

Second vice-president, William McIntosh, superintendent motive power, Central Railroad of New Jersey.

Third vice-president, H. H. Vaughan, superintendent motive power, Canadian Pacific Railroad.

Treasurer, Angus Sinclair, editor *Locomotive Engineering,* New York city.

Executive committee—C. A. Seley, mechanical engineer, Chicago, Rock Island & Pacific Railroad; A. E. Mitchell, superintendent motive power, Lehigh Valley Railroad; G. W. Wildin, mechanical superintendent, Erie Railroad; A. E. Manchester, superintendent motive power, Chicago, Milwaukee & St. Paul Railroad; J. F. Walsh, superintendent motive power, Chesapeake & Ohio Railroad; F. H. Clark, superintendent motive power, Chicago, Burlington & Quincy Railroad.

In connection with the convention an exhibition of railway appliances was held. The exhibits were placed on the verandas of the Manhattan Beach and Oriental hotels, and in the space back of the Oriental Hotel and outside the enclosure. The exhibits were about 200 in number, and were well arranged. A great number of railroad appliances and auxiliary apparatus were shown. Among the firms exhibiting may be mentioned the following:

The Adams & Westlake Company, Chicago, which exhibited the Newbold electric car-lighting system, the Adlake acetylene gas car-lighting system, railway lanterns, signal lamps, oil, gas and electric chandeliers. Represented by E. L. Langworthy, A. S. Anderson, F. N. Grigg, R. M. Newbold, G. L. Waters and E. H. Stearns.

The American Brake Shoe and Foundry Company, Mahwah, N. J., modern steel back brake shoes and steel castings. Represented by Otis H. Cutler, J. D. Gallagher, J. B. Terbell, F. W. Sargent, J. S. Thompson, W. S. McGowan, Jr., F. L. Gordon, L. J. Hibbard, B. S. Hatch and G. K. Austin.

The American Carborundum Company, New York, had an exhibit of carborundum in various forms, namely, ores, grains and wheels. Represented by George F. Hardy.

The Anglo-American Varnish Company, Newark, N. J., exhibited a number of different varnishes. Represented by William Marshall and George M. Ballard.

The Baldwin Locomotive Works, Philadelphia, Pa., had an exhibit of a Baldwin four-cylinder balanced compound locomotive, built for the Oregon Railroad and Navigation Company, on the exhibition track. W. J. McCarroll, L. H. Fry and F. Woollven were in charge.

The Bridgeport Safety Emery Wheel Company, Incorporated, Bridgeport, Ct., exhibited a number of its motor-driven grinding machines. It also showed a number of different types of emery and corundum wheels. The president of the company, D. T. Homan, was in charge.

The Booth Water Softening Company, New York, had a railroad water softening machine with a capacity of 200 gallons

per hour. L. M. Booth, E. Richardson and H. H. Sutro were in charge.

The Bullard Automatic Wrench Company, Providence, R. I., exhibited adjustable pipe and nut wrenches. J. L. Blaisdell was in charge.

The Carborundum Company, Niagara Falls, N. Y., exhibited a number of its products, such as carborundum wheels, paper, cloth and other carborundum specialties, and carborundum fire sand for lining brass furnaces. The company was represented by F. H. Manly, E. J. Eames, Emil Ulrich and Eugene Ulrich.

The Chicago Car Heating Company, Chicago, showed a vapor system of car heating and a number of improvements in car-heating specialties. The company also had on exhibition a standard straight steam-heating system. It was represented by E. H. Schrieber, T. F. Downing and E. H. Gold.

The Cling-Surface Company, Buffalo, N. Y., showed a model equipped with a treated and an untreated belt. The treated belt was running slack, and the untreated one tight. The company was represented by Charles F. Chase and Joseph E. Sherry.

The Consolidated Railway Electric Lighting and Equipment Company was represented by Col. John T. Dickinson, T. L. Mount and P. Kennedy. The company had an exhibit on the veranda of the Manhattan Beach Hotel, showing an axle-driven dynamo and electric train lighting system

The Consolidated Car Heating Company, Albany, N. Y., exhibited steam-heating apparatus; also an automatic coupling apparatus and automatic traps. There was also shown in operation an automatic axle-lighting system. The company was represented by Francis C. Green, Cornell S. Hawley, James F. McElroy, W. S. Hammond, Jr., S. B. Keys and C. C. Nuckols.

The Dearborn Drug and Chemical Works, Chicago and New York, exhibited a number of chemicals used for water softening. William H. Edgar, W. B. McVicker, Robert F. Carr, Robert W. Francis were in charge.

The Joseph Dixon Crucible Company, Jersey City, N. J., exhibited Dixon's graphite lubricants and Dixon's silica graphite paint. H. A. Nealley, G. P. Hutchins and C. H. Spotts were in charge.

The Electric Controller and Supply Company, Cleveland, Ohio, showed the Deutsch electric train-lighting system in operation. It was represented by I. Deutsch, W. W. Adams and W. A. Ten Winkel.

The Electro-Dynamic Company, Bayonne, N. J., had a number of its "Interpole" variable-speed motors in operation at the Manhattan Beach Hotel. G. H. Condict, H. McL. Harding and T. B. Peck, Jr., represented the company.

The Foster Engineering Company, Newark, N. J., had on exhibition the different types of valves manufactured by it. These included reducing, stop and back-pressure valves, and valves for use in train-heating systems. The Foster pump governor was also shown. H. C. Foster and J. D. Owen were in charge.

The General Electric Company, Schenectady, N. Y., exhibited a mercury arc rectifier in operation and a system of straight and automatic air-brakes. The company also had on exhibition automatic block signal apparatus and a moving picture showing a race between the new electric locomotive built for the New York Central & Hudson River Railroad Company and a steam locomotive drawing one of the regular passenger trains. The company was represented by Gen. Eugene Griffin, J. R. Lovejoy, J. R. McKee, William J. Clark, L. R. Pomeroy, W. B. Potter, A. H. Armstrong, F. H. Gale, C. L. Pierce, H. D. Hawkes, W. M. Wright, E. M. Kinney and M. B. Jones.

The Gold Car Heating and Lighting Company, New York, exhibited car-heating apparatus, car-lighting apparatus and regulators for car heat. E. E. Gold, John E. Ward, W. E. Banks, B. H. Hawkins, A. E. Robbins, W. H. Stocks and Richard Voges were in charge.

The Goldschmidt Thermit Company, New York, made demonstrations every day of the welding of steel by the Goldschmidt process. W. M. Carr was in charge of the exhibit.

The Gould Coupler Company, New York, exhibited an electric car-lighting system and various forms of couplers, draft gears and brake apparatus. W. S. Gould, F. P. Huntley, T. L. McKeen, S. R. Fuller, George T. Milne, M. H. Sheed, W. R. Turbayne and W. F. Richards represented the company.

The International Correspondence Schools, Scranton, Pa., had an exhibit showing its method of instruction by correspondence. W. N. Mitchell, J. F. Cosgrove, Edward M. Sawyer and C. B. Congor were in charge.

The H. W. Johns-Manville Company, New York, had an exhibit showing various forms of coverings and non-heat-conducting materials. J. E. Meek, J. C. Younglove and L. B. Melville were in charge.

The Pedrick & Ayer Company, Plainfield, N. J., exhibited portable tools for railroad shops. The company was represented by R. O. Cumback and F. S. Healey.

The Pyle-National Electric Head Light Company, Chicago, exhibited a number of electric headlights for locomotives. Mark A. Ross and J. W. Johnson were the company's representatives.

The Robins Conveying Belt Company, New York, had a working model of a sixteen-inch conveyer on exhibition. The model showed discharge spouts, automatic reversible tripper, and different angles of working. A. B. Proal, Jr., E. S. Stadelman and Thomas Robins represented the company.

The Safety Car Heating and Lighting Company, New York, exhibited in the Oriental Hotel and in a Long Island Railroad car on the exhibition track its system of car lighting by the incandescent mantle system. The company also exhibited its steam-heating apparatus. R. M. Dixon, E. F. Slocum, William St. John, W. H. Hooper, F. A. Brastow, J. S. Henry, B. V. H. Johnson, G. E. Hulse and A. Sebold represented the company.

The Sprague Electric Company, New York, exhibited steel-armored steam and air hose and flexible armored conduit and cables. The company also had in operation a one-ton stationary electric hoist and a four-ton traveling electric hoist. A. C. Bakewell, E. H. Watlington and F. S. Douglass were in charge.

The Standard Coupler Company, New York, exhibited a standard steel platform with attachments, and also Session-Standard friction draft gear. George A. Post, A. P. Dennis, E. H. Walker, R. D. Gallagher and A. N. Cook represented the company.

The Standard Paint Company, New York, had an exhibition of Ruberoid roofing, and also insulated papers and preservative paints. It was represented by Ralph L. Shainwald, J. N. Richards, Paul M. Wade, Charles Earnshaw and J. H. Thomas.

The Star Asbestos Manufacturing Company, New York, exhibited a line of high-pressure asbestos packings. Edward D. Farmer, president; John R. Robinson, vice-president; J. D. Drew, treasurer, and G. E. Sutton, secretary.

The United States Lighting and Heating Company, New York, had in operation its system of car-lighting by means of a dynamo belted to the axle. It was represented by A. S. Adler, H. K. Brooks and Morris Moskowitz.

The Walworth Manufacturing Company, Boston, had an exhibition of injectors, valves and pipe tools. It was represented by George E. Pickering and George Elliott.

The Westinghouse Air Brake Company, Pittsburg, Pa., had an exhibition showing the Westinghouse friction draft gear and a number of air brake outfits. The company was represented by H. H. Westinghouse, E. M. Herr, E. L. Adreon, N. F. Niederlander, C. R. Ellicott, A. L. Humphreys, J. R. Ellicott, H. S. Kolseth, Frank Whitney, F. M. Nellis, George Baker, T. R. Burton, Walter V. Turner, Robert Burgess, James S. Siegrist, S. D. Hutchins, L. F. Purtill, R. H. Blackall, F. V. Green and S. J. Kidder.

The Westinghouse Air and Automatic Steam Coupler Company, St. Louis, Mo., showed the Westinghouse air and steam couplers. The company was represented by N. F. Niederlander, E. L. Adreon and R. E. Adreon.

The Wheel Truing Brake Shoe Company, Detroit, Mich., exhibited a number of abrasive brake shoes for truing flat wheels. J. M. Griffin was in charge.

The Yale & Towne Manufacturing Company, New York, showed a number of chain blocks, electric hoist and overhead trolleys, and also different types of Yale locks. The company was represented by C. W. Beaver and William Hazleton.

Reviews of Current Engineering and Scientific Literature.

Notes on the Compensated Single-Phase Shunt Motor.

In these two articles M. J. Bethenod discusses, at some length, the theory of the single-phase compensated shunt motor, a design due to Latour. The motor differs from the so-called single-phase commutating type in having the field circuit connected in parallel with the armature circuit, and in having, in addition, a pair of short-circuited brushes. There are thus three circuits, one through the shunt field, one through the series field, armature and a regulating resistance, and the third through the short-circuited brushes. This peculiar arrangement has the following characteristics: the speed is practically constant for a given condition, and in this respect the motor may be compared with the direct-current shunt motor, as it is a constant speed machine. The power-factor may be regulated, which is an advantage in point of view of the supply system. Although the starting effort is slight, this is not an inconvenience, since the motor may be started as a repulsion motor. When the speed of the motor exceeds that of synchronism, it may be used as a generator, and return power to the line. The motor commutates well at or near synchronism. It is the only design of a single-phase commutating motor which gives a constant speed, and it is thought that it will become an important type in the future.—*Translated and abstracted from L'Éclairage Électrique (Paris), March 4 and May 27.*

The Zirconium Lamp.

In a summary which is given here of the new types of lamp, M. Léon Versé describes the zirconium lamp, which is due to Wedding. The filament is made by mixing the oxides of zirconium with those of magnesium, and submitting them, at a high temperature, to the action of hydrogen. A compound is thus formed. This is then pulverized and mixed with cellulose, so as to form a plastic, homogeneous mass, which is squirted to form filaments. The filaments are subsequently carbonized in an atmosphere of oxygen, and then present a metallic appearance. One kilogramme of zirconium is sufficient to produce 100,000 filaments. The lamp may be sold at about fifty cents, and its specific energy consumption is about two watts per candle. Lamps are now made for thirty-seven or forty-four volts, and are used three in series on 110-volt circuits, or five in series on 220-volt circuits respectively. For luminous intensities of from 60 to 100 candles several filaments are connected in series and mounted within the one globe. Tests indicate that the lamp has a life of from 700 to 1,000 hours.—*Translated and abstracted from the bulletin of the Société Blege d'Électriciens (Brussels), May.*

The Single-Phase Railway System in Italy.

A description is here given by Mr. E. A. Kerbaker of the single-phase railway system as it has been applied to an electric road running from Rome to Civita Castellana. The traffic along this road is not dense, but the district is not served by any other road. The construction of the road has been commenced. The Westinghouse single-phase system will be used. The line is thirty-three and one-half miles long, and eventually will be forty-six miles long, as an extension will run to Viterbo. The district is mountainous, and some of the grades are steep, one being fourteen per cent. The power station will be at Ponte Milvio, two and one-half miles from Rome. It will be equipped with steam turbines rated at 300 horse-power, driving single-phase alternators. The supply will be at twenty-five cycles, 6,000 volts. The track has a gauge of one metre. The rails weigh seventy pounds per yard over that section of the road nearest Rome, and forty-two pounds beyond. The track is laid down on the old Via Flaminia. Only one side of the track is bonded, except between Rome and the power station. The pressure will be 550 volts on this section where there are two No. 00 trolley wires, while the other part of the road has but a single No. 0 trolley wire. This wire has a figure 8 section, attached to mechanical ears made of steel, and suspended so as to obtain double insulation. Two porcelain insulators are suspended by brackets by means of bolts. These are tested up to 20,000 volts. The second insulation consists of two insulators, to the ends of which are fixed, with a special cement, two hooks which hold the steel suspension wire. These insulators are tested at 40,000 volts. Chestnut poles from twenty-eight to thirty feet long are used. On these are mounted three insulators, two for the telephone service, and the third for the pilot wire. This pilot wire is to protect the system and persons in case the line should break. The trolley wire on the high-voltage section is continuous. Where turnouts are necessary it takes the form of an S, doubling back on itself so that there will, at no point, be two live wires connected in parallel. The pilot wire is attached to the far end of the trolley wire, while at the power-house it is attached to one terminal of the primary of a transformer. The other terminal is connected to the rail. The secondary of this transformer supplies a small current to an electromagnetic switch, holding it open as long as the trolley wire is unbroken. Should the trolley wire break, the current will be interrupted, the switch will drop and open an oil circuit-breaker. There is also an overload relay which trips the circuit-breaker when the main current exceeds a certain value. The cars are mounted on four-wheel trucks, each is equipped with two forty-horse-power, 250-volt, twenty-five-cycle, single-phase motors. There is one main transformer for primary pressures of 550 and 6,000 volts, and for a secondary pressure of approximately 250 volts.—*Abstracted from the Electrical Review (London), June 2.*

A Plea for Larger Units.

In this communication Mr. W. A. Vignoles, electrical engineer for the Grimsby Electricity Works (England), considers the saving in steam which would be effected if his plant were equipped with 1,000-kilowatt units instead of smaller units. At present there are installed two 220-kilowatt, four ninety-three-kilowatt, and two forty-four-kilowatt generating sets. The results of a test of this plant were given in the London *Electrician* for April 28. Mr. Vignoles estimates that the auxiliaries will require 5.7 pounds of steam per kilowatt-hour; that the 1,000-kilowatt units will require about 700 pounds of steam per hour at no load. The forty-four-kilowatt sets used at the present time take at no load only 130 pounds of steam. The auxiliaries will require about the same amount in either case. Against the saving at light loads due to the smaller units must be reckoned a saving in the reduced condensation, in the steam range, and in the leakage of drains which would be effected if the larger units

were installed. This is assumed to be about five per cent of the steam required at no load. From these data curves are plotted, according to Willans straight-line law, which show that the steam consumption per kilowatt-hour will be greater for the 1,000-kilowatt set than for the smaller at any load up to sixty-five kilowatts, but at any load above this the larger unit takes less steam. If the mean load on the plant during running hours be known, the saving in steam consumption by using the large unit can be determined. During the year ending March 31, 1905, the average load on the Grimsby plant was 160 kilowatts, and the saving in steam per hour by using a 100-kilowatt set would therefore have been about 700 pounds. The plant was in use about 7,209 hours, hence the total steam saved would have been over 5,000,000 pounds; and allowing six and one-quarter pounds of water evaporated per pound of coal, a saving of 360 pounds of coal, costing $472.50, would have been made. The author lays emphasis upon the desirability of having a standard size of unit. By the method outlined the largest size desirable can be determined, and the necessary power obtained by putting in as many of these sets as are needed.—*Abstracted from the Electrician (London), June 2.*

The Serius Accumulator.

A description is here given by M. Paul T. Pausert of a new French storage battery which is thought to have some decided advantages. The author first explains the necessity for a new type by pointing out the disadvantages of other types. Plates cast in the ordinary way can not be made to have large surface because, if the ribs are thin, the plates can not be taken out of the mould, and, besides, a cast plate is never perfect. The surface can be increased by machining the plate, but when an ordinary cutter is used, the blanks must be made of rolled lead, because the cast plate will not stand the work. The Serius plate belongs really to the latter type, but the machining is done in such a way as to make possible the use of a cast blank. The blanks are cast to the exact dimensions, and with all extensions necessary for suspension and electrical connection, except they are thinner than the finished plate. These blanks are then placed in a special machine furnished with rows of conically-shaped cutters arranged on each side of the plate. The machine is designed so that these cutters can be changed or can be brought closer together or moved further apart. The blank plate is placed in a frame which is oscillated rapidly back and forth between the cutters. The latter are gradually advanced. The action is rather that of rolling deep grooves into the plates than of cutting grooves. It not only raises the ribs on the surface so as to make the plate thicker, but the action of adjacent cutters is to compact the lead, making each rib solid and perfect. The thickness of these ribs may be not more than 0.2 of a millimetre. The cutters are spaced so as to divide the plate into sections of ribs, each section being separated from the next by a thicker portion of the lead. This process enables a cast plate to be used, produces a plate of uniform character, and is rapid. No data as to the performance of these plates are given.—*Translated and abstracted from La Revue Électrique (Paris), May 30.*

The Blake-Morscher Electrical Ore Separator.

A description of the Blake-Morscher electrical ore separator is given here by Mr. A. M. Plumb. As is well known, this device takes advantage of the different rates at which conducting and non-conducting particles become charged when passed over an electrically charged surface. The ore is ground fine and passed over a metallic roller charged by a static machine. The conducting particles are repelled, but the others are not affected, so that a separation is thus obtained. This separation is not perfect, however, but by properly dividing the stream of particles any desired degree of separation can be obtained. Results are given showing the performance of the machine when treating different kinds of ores. An ore which was useless before treatment became worth thirteen dollars per ton for the zinc, and two dollars for the silver which it contained after passing through a Blake machine. The machine may be used for separating zinc and iron, zinc and lead, for concentrating copper ores, and for concentrating gold ores containing iron. In an instance mentioned, seventy-four per cent of the gold was saved, the concentration being increased from 0.8 ounce to 2.42 ounces per ton. The charging current may be supplied by any improved type of static machine. The one used in the experiments mentioned was driven by a three-eighths-inch belt. Two men are sufficient to take care of a plant containing three machines during one shift.—*Abstracted from the Mining Magazine (New York), June.*

Purifying Drinking Water by Electricity.

United States Consul-General Guenther, Frankfort, Germany, communicates the following:

The Frankfort *News* states that it is probable that electric purification of drinking water will soon be introduced into the home. This method, already used by a number of municipal waterworks, is based upon the germ-killing effects of ozone, which is cheaply engendered by electricity. If an electric discharge takes place between two glass tubes, one inside the other, whose surfaces facing each other are coated with metal, ozone is developed in the space between the tubes.

Electricians have tried in recent years to simplify the means of electric ozone development for purifying water. The ideal apparatus would be one which every housekeeper could put in the kitchen, and by utilizing the electric current of the common electric light wires purify every glass of drinking water. According to the Frankfurter *Umschau,* such an apparatus seems to have been successfully made by a French engineer, Mr. Otto.

This apparatus is of very simple construction and takes up little space. It consists principally of a small, closed box, the metal cover of which is made conductory with the bottom. In the box is an ozone developer, an interrupter, and a tin tube. Through the latter the ozone, which first has to pass through a cotton stopper to free it from dust and germs contained in the air, is conducted into the water and mixed therewith. If much ozone has been absorbed, the water becomes phosphorescent in the dark. The most important part of the apparatus is the "mixer," action of which can be interrupted at will. The apparatus is capable of purifying about sixty gallons of water an hour, and the cost per hour is about the same as that of an ordinary electric incandescent light.

The Celebes-Guam Cable.

It is stated that the cable steamer Stephan, of the North German Cable Works, of Nordenham, has completed the laying of a cable between Menado-Yap and Guam, for the German-Holland Telegraph Company, of Cologne. The length of this cable is nearly 2,000 miles, its weight about 4,000 tons, and the greatest depth attained, 2,300 feet. By this cable the Dutch-India colonies and the German Carolines are placed in communication with the American Pacific cable. The Stephan is now proceeding to Shanghai to lay a cable 130 miles in length along the coast, which will form part of the Shanghai-Yap cable, of which the main line is now being constructed by the North German Cable Works, and which, it is expected, will be laid next winter.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Method of Testing Lubricants.

United States Commercial Agent Harris, Eibenstock, Germany, communicates a new method of testing lubricants.

In some cases the thickness of the oil is the more important factor, in others the internal frictional resistance. In the few main bearings of large machinery less importance attaches to the internal frictional resistance than to the requisite viscosity of the lubricant at the highest temperature likely to occur, so that a sufficiently thick supporting layer between the rubbing surfaces will be maintained in spite of the high pressure on the bearings; for in this case the loss by friction is of little moment in comparison with the total output of power. In other cases, however, where the losses due to friction

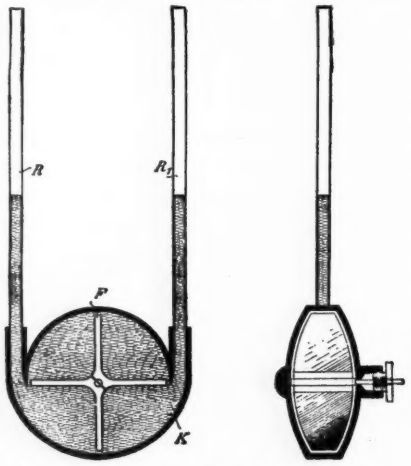


FIG. 1.—FRONT AND SIDE ELEVATION OF OIL-TESTING APPARATUS.

in the bearings constitute a large proportion of the entire power consumed, as, for example, where extensive shafts drive numerous small machines, any slight addition to the frictional resistance at each bearing surface has a marked influence upon the total consumption of power. This, of course, affects the economy of working, and in such cases an oil should be chosen which minimizes the frictional resistance.

For the purpose of determining these two characteristic physical properties the Gebrüder Körting Electrical Company (Limited), Berlin, has devised an important method of testing lubricants. The following description will serve to give a clear idea of the machinery used. In Fig. 1, K is a closed chamber which is filled with the lubricant to be tested. Within this chamber a fan F is made to rotate, the driving shaft projecting from the side of the chamber through a stuffing box. The fluid in chamber K has two communicating tubes, R and R_1, fitted to it, in

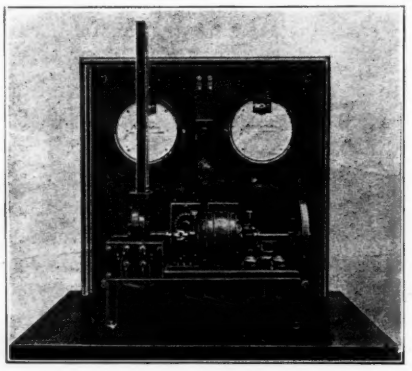


FIG. 2.—FRONT VIEW OF APPARATUS FOR TESTING LUBRICANTS.

which the lubricant rises about to the middle. When the fan is started the oil in the chamber is compelled to participate in the motion, and hence friction is established between the moving portion of the lubricant in the chamber and the stationary portion in the tubes. The frictional resistance thus produced causes the oil to rise in one tube and to fall in the other. The difference in the levels of the fluid columns, taken in conjunction with the specific gravity and temperature of the oil and the velocity of motion, affords a measure for the internal frictional resistance of the lubricant.

Figs. 2 and 3 show an apparatus by

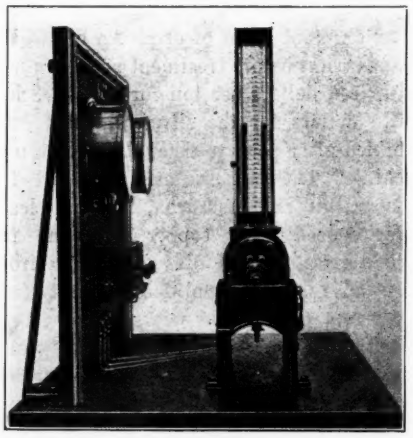


FIG. 3.—SIDE VIEW OF APPARATUS FOR TESTING LUBRICANTS.

means of which various lubricants may be tested by the method just described. In front will be seen the chamber with its two vertical tubes. The chamber rests in a large vessel serving as a heating bath. The shaft projecting through the side of the casing is coupled to a small electric motor, by which the fan is set in motion. The uniformity of the motion is increased by a small flywheel. The speed of the electric motor is variable within wide limits, so as to afford a convenient means of determining the connection between the frictional resistance and the velocity, and the bath surrounding the oil chamber, which may be heated electrically or in some other suitable manner, provides means of testing oils at different temperatures. The energy consumption of the motor also furnishes a measure for the viscosity of various lubricants used under similar conditions, that is, when temperature and speed is the same; or a particular oil may be tested at different temperatures with a constant speed.

The speed of the motor is regulated by finely graduated resistances, and the revolutions are counted by a speed counter, while the energy used is indicated by an ampere-meter and voltmeter, and the temperature by thermometers. The result of the test is readily ascertained after a few readings. This method enables factory managers to select lubricants best adapted for their plants and to test the value of lubricating oil offered to them.

The Ganz System of Three-Phase, Alternating-Current Electric Traction in the United States.

The Ganz system of three-phase, alternating-current electric traction, well known in Europe, is to be introduced in the United States. This system is to be exploited by the Railway Electric Power Company, in which several New York capitalists and railroad men are primarily interested. The company has acquired the electric traction patents and manufacturing rights of Ganz & Company, of Budapest. These rights, etc., cover the United States, Mexico, Cuba and all the West Indies other than those under British supremacy.

The board of directors of the company is composed of John E. Borne, president of the Colonial Trust Company; William L. Bull, of Edward Sweet & Company; Henry Seligman, of J. & W. Seligman & Company; Stephen Peabody; H. R. Duval, of the Atchison, Topeka & Santa Fé Railroad; Leopold Wallach, of Wallach & Cook; Henry L. Sprague, of Stetson, Jennings & Russel; Gustav Lindenthal, commissioner of bridges; and Gustave Leve. L. B. Stillwell, electrical director of the Interborough Rapid Transit Company, and Frank N. Waterman are the consulting electrical engineers.

TYPO-TELEGRAPH.

BY FREDERICK J. SWIFT.

This new principle of printing telegraphy was originated by Dr. George A. Cardwell, and is fully covered by patents in this and foreign countries. Three impulses only are required for each character printed, and all impulses for every character are of the same duration. The mechanism required at every station will not cover, for both sending and receiving apparatus, more than twelve by twenty inches on any table, and can be carried from place to place by any one. There is no tape sending or receiving. A copy of the message sent is printed in page form immediately before the operator's eyes. Any reasonable number of stations can be operated from the one place and the system can be duplexed or multiplexed. The fundamental principle is the selective permutation of local circuits, by means of combinations of plus and minus line impulses.

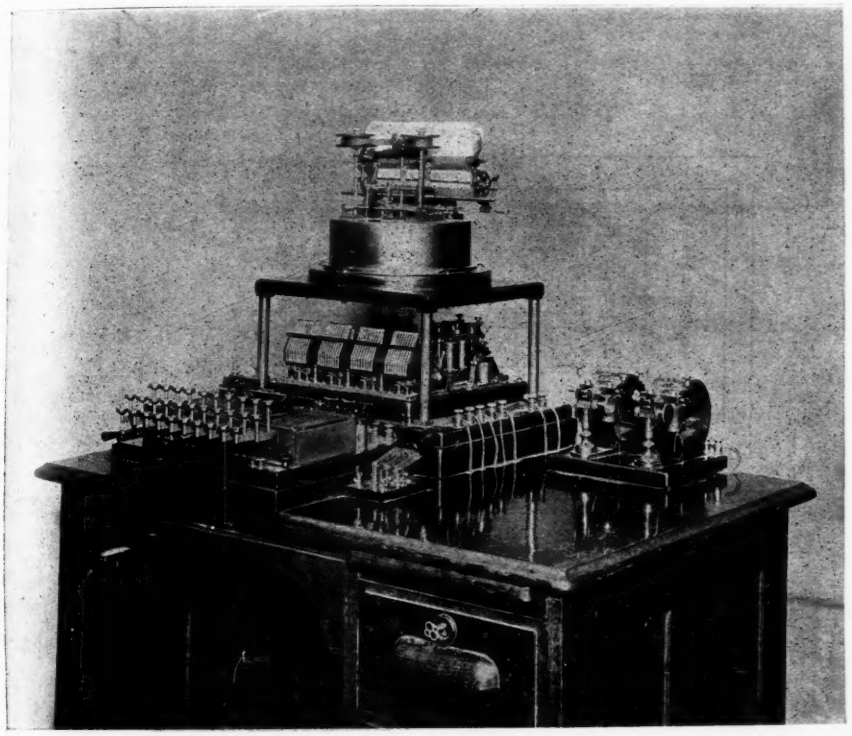


FIG. 1.—COMPLETE TYPO-TELEGRAPH STATION.

The selective scheme is based on the number of permutations of four things, taken three at a time. The transmission of a character, or the execution of a distant function, is performed by executing three of four possible functions in the proper order. Therefore the system may be worked over one wire with earth return, by means of plus and minus line impulses of two current strengths, or it may be worked over two wires with earth return, by means of plus and minus impulses on each wire of only one current strength.

The number of permutations of four things, taken three at a time, is twenty-four, when no permutation contains a repetition. Including repetitions there are sixty-four possible permutations. On account of the tailing of impulses in the line, the permutations having successive repetitions were discarded, leaving thirty-six useful permutations. Of this thirty-six only twenty-seven are needed for the characters and five for auxiliary functions —a total of thirty-two. The permutations in use for line signaling are shown below. That is, 1 and 2 may be respectively plus and minus line impulses of one current strength, and 3 and 4 plus and minus of a second current strength; or 1 and 2 may be impulses on one wire and 3 and 4 on a second wire.

SPACE	1-2-1
A	1-2-3
B	1-2-4
C	2-1-4
D	2-1-3
E	2-1-2
F	3-2-4
G	3-2-3
H	3-2-1
I	1-3-2
J	1-3-1
K	1-3-4
L	4-1-3
M	4-3-2
N	4-3-1
O	2-3-2
P	2-3-4
Q	2-3-1
R	1-4-1
PERIOD	1-4-2
S	1-4-3
T	2-4-1
U	2-4-3
V	2-4-2
W	4-1-4
X	4-2-3
Y	4-1-2
Z	3-1-4
FIGURES	3-4-3
CAR. RETURN	3-4-1
LINE SPACE	3-4-2
FIG. RELEASE	4-3-4

The keyboard from which these impulses are sent is of the universal type, and is arranged to close the local circuits of a series of magnets, which in turn transmit the line impulses. The impulses are of the same length, with equal intervals between the three impulses: the lengths of impulse and interval are controlled by interposing a series of local relays in the transmitting circuit, each of which energizes the next, etc., the last one closing the line circuit.

A general view of one complete station is shown in Fig. 1.

The three essential groups into which the mechanism may be divided are the keyboard transmitter, the distributor and the printer. The home record of transmission is obtained from the home line relays, which in turn operate the home distributor and the printer, and therefore it is possible to "break" the sending, from the distant receiving station, and the home record shows that the line is operating properly. Further than this, the combination of local locking relays in the transmitting circuit is unlocked only when the home printer is executing its record of the transmitted signal.

The principles and the circuits of the transmitter are illustrated in Fig. 2. The keyboard contains thirty-two keys, of which twenty-seven are for printed characters, the remaining five being the "spacing," "line space," "carriage return," "shift to figures" and "release." Each key lever is arranged to depress three of twelve bars, as shown in the figure; each bar closes a single contact. The six local relays are arranged to control the interval between the impulses, as well as the length of impulses; there may be more or less than six of these relays, according to the desired speed. The first impulse goes directly to line, when a key is depressed; the second follows when the distributor acts and local relay No. 2 is closed; the third takes place when local relay No. 6 acts, and the whole set of local relays is unlocked when the distributor unlocks and the circuit of local relay No. 1 is thereby opened.

Trace the transmission of the letter N. The combination is 4-3-1; this means a

negative impulse on L 2 followed by a positive impulse on L 2, and then a positive impulse on L 1. Depressing the key N on the keyboard will close the following contacts on the rear of the keyboard, as shown in Fig. 4: No. 1 in the group K, No. 2 in the group L and No. 3 in the group M. No impulses will pass to the line until K-1 is closed and then a negative impulse passes to the line L-2; the polar line relay in L-2 will close the distributor; and the circuit of local relay No. 1 will thereby be closed. Local relay No. 1 will close local relay No. 2, and No. 2 will throw the switch C-1 to its other position, opening the circuit through K-1 and closing the line L-2 through the contact 1-2, sending a positive impulse over L-2. Local relay No. 2 will close No. 3 and No. 3 will close No. 4, etc., until No. 6 is closed. Local relay No. 6 will switch the contacts C-2 to the other position, opening the circuit through 1-2 and closing the line L-1 through the contact M-3, sending a positive impulse over L-1.

On the third impulse the distributor completes its permutations and actuates the printer; at the same time the distributor currents are automatically unlocked, and the circuit of local relay No. 1 is thereby opened by the distributor. The whole bank of six local relays then unlocks, and all circuits and contacts are in readiness for the transmission of another character.

The distributor circuits are shown in Fig. 3; the locally permuted printing circuits are shown in full, although some of the auxiliary relay circuits and contacts have been omitted in order to show the principle more clearly. All of the functions, however, will be described. The polar line relays and their line connections are shown at the top of the figure. The process of selective permutation involves three consecutive steps, and upon the completion of the third step the permutation is completed and a selected circuit, containing battery, is closed, while the function corresponding to the combination of three-line impulses is duly executed. The two-line relays control four local circuits, each of which contains a self-locking relay; these relays are shown as 1, 2, 3 and 4 in the figure. Relay No. 1 controls the sets of contacts *a*, *a'* and *a"*; the contacts *a"* are operated by the relay 1' which is in series with relay No. 1, but does not lock; relay No. 1 is double-wound and the extra circuit is the locking circuit. That is, a + impulse on L-1 will close the contacts *a*, *a'* and *a"*, the contacts *a* and *a'* being locked and *a"* closed only momentarily.

Similarly, relay No. 2 controls *b*, *b'* and *b"*. The contacts *a*, *b*, *c*, and *d* are arranged on a shaft which is operated by the relay H, in the common return of the locking circuit; when the armature of one of the four relays is actuated, the relay H rotates the shaft slightly and the particular armature which is down will close its local circuit. The remaining three circuits will remain open until H is unlocked, because the contacts have been rotated into a position such that the relay armatures will not close them. That is, when any one of the four relays 1, 2, 3 and 4 operates, it closes and locks its contacts in the first and second groups and also locks open the three remaining contacts in the first group.

Trace the reception and printing of the character "N"; the line impulses are — on L-2 followed by + on L-2 and + on L-1. The first impulse will close relay No. 4, and will lock in a closed position the contacts *d* and *d'*, while *a*, *b* and *c* are locked open; the contacts *d"* will be closed momentarily. The second impulse will close and lock the relay No. 3, and its contacts *c'*; the contact *c* is locked open; the contacts *c"* will be closed momentarily. The last impulse will close relay No. 1; and when the contacts *a"* are closed the letter "N" will be printed, because a circuit has been established from the contact *d* to contact No. 4 in group *c'* and thence to the contact in series with the "N" magnet in the group *a"*. The other contacts in the group *a"* are closed simultaneously, but no other closed circuits are established. Likewise the contacts in the groups *a'*, *c'* and *d'* were closed, but again no closed circuits were established when *a"* closed, except through the "N" printing magnet. The distributor has selected and operated the "N" magnet, but the relays No. 1, No. 3 and No. 4 are still locked.

The magnet P, in the common return of the distributor, is double-wound, and the extra winding is arranged to make the magnet self-locking. This magnet P closes a circuit which actuates the printing hammer, by means of a local magnet

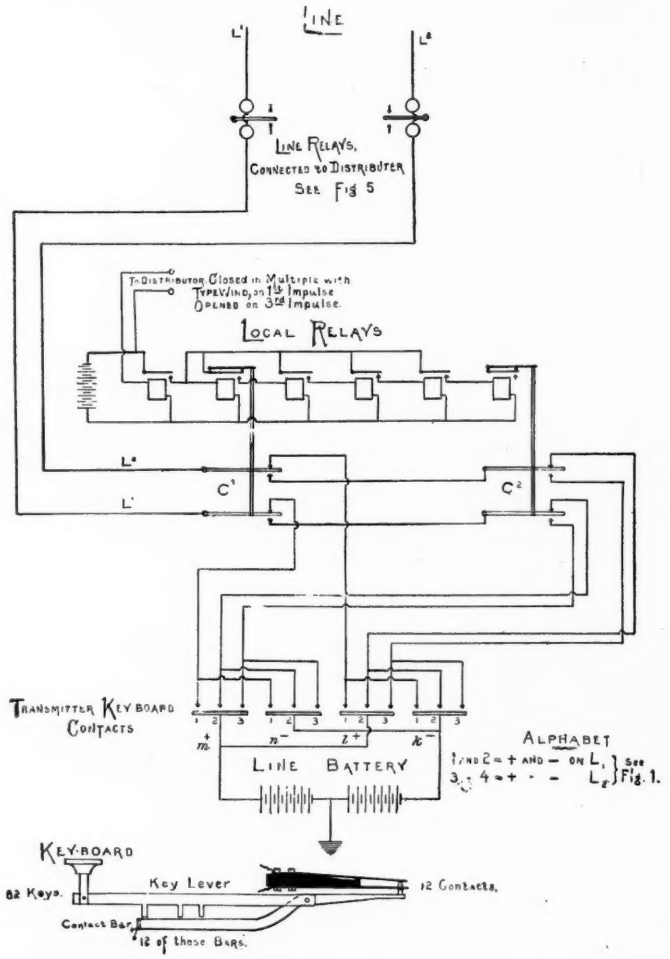
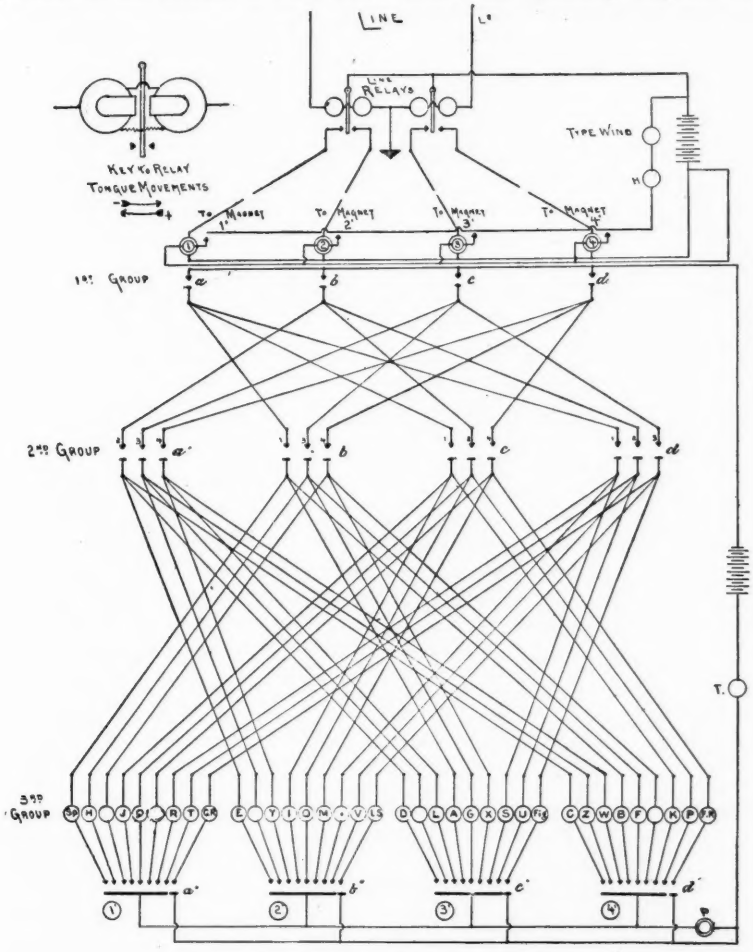


FIG. 2.—PRINCIPLES AND CIRCUITS OF TYPO-TELEGRAPH TRANSMITTER STATION.

on the printer. The locking winding of P is short-circuited by the local printing magnet which actuates the hammer. The magnet T breaks the locking circuit of the relays No. 1, No. 2, No. 3 and No. 4 and operates a trip magnet on the printer. The local circuits of P and T are so associated that their functions are executed in their proper order. The contacts for the "carriage return," "line space," "shift to figures" and "release" are completed through a separate return conductor, to avoid actuating the printing hammer.

It will be noticed, in Fig. 3, that the distribution of the circuits is such that



PRINTER, TYPO-TELEGRAPH STATION.

contacts in the first group close circuits to the other letters in the second group, and that contacts in the second group again close circuits to different letters in the third group; this arises from the omission of consecutive repetitions in the line signals and considerably simplifies the circuits and mechanism.

The printer contains twenty-nine local magnets, of which twenty-eight are shown in Fig. 3—the additional magnet being the trip magnet. The carriage spacing is effected by the magnet which actuates the printing hammer. There is one magnet for each of the functions, "line space," "carriage return," "shift to figures" and "release." The type-wheel spindle is actuated by a spring, which is wound by the type-wind magnet; this magnet is energized each time the distributor acts and is closed on the first impulse, as shown in Fig. 3. The type-wheel has two complete, circumferential rows of characters —one of letters and one of figures. The figures are brought into position by shifting the type-wheel along its axis. The type-wheel spindle is vertical, and carries a horizontal arm near its lower end. The twenty-nine printing magnets are arranged on a circular circumference, and each one, when energized, will raise its armature to a position in which it will engage the horizontal arm on the type-wheel spindle. The ends of these armatures which engage the arm on the spindle lie normally in radial slots in a horizontal disc. The armatures are normally horizontal, but when they are raised to engage the arm are clear of the disc, and are locked up by a slight rotary movement of the disc, which prevents their falling into normal position. The armature of the trip magnet will not, however, lock; and the function of the trip magnet is to release the armature last raised, just before the printing of another character. The trip magnet armature, when it is raised, moves the disc slightly in a rotary direction so as to release any other armature levers previously locked up. When a character is to be printed, the action of the trip magnet immediately precedes the raising of the armature which will stop the type-wheel in position for the characters to be printed. The action of the printing hammer actually prints the character; the printing hammer is actuated, as described, by the printing magnet.

The system as described works on the open-circuit plan. Intermediate stations may be employed. Sending from intermediate stations requires a line battery at the station. The system may also be operated on the closed-circuit plan, thus avoiding the necessity for separate line batteries at the intermediate offices. The voltages and currents employed are of the magnitude ordinarily used in commercial telegraphy; the normal strength of the line impulses is about thirty miliamperes—or 0.030 ampere.

The first commercial tests of the typo-telegraph were made on the Long Island Railroad Company's wires in 1901. A speed of fifty words per minute was readily maintained over circuits two hundred and forty miles in length, the longest obtainable on that road, of iron wire and in ordinary commercial condition.

Later tests were made over commercial telegraph circuits up to five hundred miles in length, with the most satisfactory results. The transmission is not interfered with by looping intermediate relays into line—which has been proven by actual trial. The various tests of the system have shown it to be commercial on ordinary telegraph circuits up to any distance commercially, operative without repeaters. As to the speed of working, no one has been able to operate the system at a speed so high that the mechanism was incapable of response. Speeds of fifty to sixty words per minute have been obtained by expert operators.

A series of very interesting tests has recently been conducted on the wires of the American Telephone and Telegraph Company. These tests were made over composited circuits from New York to Boston and return. The system was highly successful in this respect, and simultaneously telephony and printing telegraphy were practically demonstrated without interference with the telephone.

NEW YORK TELEPHONE COMPANY'S NEW DIRECTORY OUT.

EDITION FILLED TWENTY-ONE FREIGHT CARS AND WEIGHED 333 TONS—200,000 SUBSCRIBERS SHOWN.

Employés of the New York Telephone Company are now moving over 600 tons of paper, in blocks of two pounds, which means that the summer telephone directory has come from the press, and is being distributed, while the old telephone books are being collected. About one hundred and fifty men are at work on the task, which will take three or four weeks to complete.

The new directory is considered by the company to be the most satisfactory in every particular of any it has issued. Typographically it is a vast improvement over previous issues. Names of subscribers are run three columns to the page with the telephone number and exchange in heavy black-face type. The new book is much more compact than the old one, presents a neater appearance, and is much easier to handle.

It contains some 200,000 names, about one-half of which are subscribers in Manhattan and the Bronx. Twenty-one thousand names appear in this book which did not appear in the old one. Of this total gain about forty per cent was made in Manhattan.

The new directory represents twenty-five carloads of paper. After the books were printed, bound, and packed, it required twenty-one freight cars to carry them.

Although the directory is issued every four months, a dozen men are constantly at work on it. All changes, additions and removals are sent to the printer daily. They are at once issued as an addendum and forwarded each morning to the various exchanges, which are thus kept posted as to new subscribers, changes in address and number and removal of telephones.

When the new directories are delivered the old ones are taken away and are destroyed by the company. This is done for the protection and convenience of the subscriber, and to prevent the further use of the old books which would only result in errors. To do this work it really means that two complete editions shall be moved each time a new book is distributed.

The very general use of the telephone directory as a general business and social register is one of the developments of the telephone business. Originally the telephone book was prepared as a guide for telephone users only, and no one dreamed that telephone service would ever reach such a stage of development that the directory of telephone subscribers would become the best general directory of New York and vicinity. Such is now the case, however. The telephone book is brought up to date and a new issue distributed every four months, which ensures a degree of accuracy almost absolute.

Nearly every firm or individual doing business in the city depends to a great extent on the telephone service, an important part of which is the listing in the telephone book. A very large proportion of residences in the city are likewise served by the company, and the result in listings in the book make the directory exceptionally valuable from its social side.

The accuracy, the convenience, and compactness of this book, together with its broad circulation, cause it to be used almost to the exclusion of all other directories in New York city.

A New Ignition Timing Apparatus.

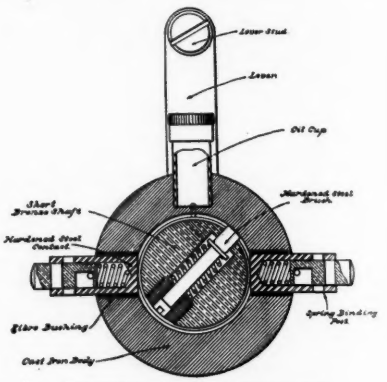
The Atwater Kent Manufacturing Works, 112 North Sixth street, Philadelphia, Pa., has placed on the market a new form of timer embodying some new and original features. The aim of the manufacturer in producing this apparatus was to bring out a timer which would be mechanically perfect, simple to handle, and electrically durable. In the new form of timer the contacts have been given especial attention, and are guaranteed to have an extremely long life. The contacts are placed in the centre of the bearing, overcoming a large part of the ordinary strain and wear, and reducing to a minimum the possibility of the contacts getting

IGNITION TIMING APPARATUS.

out of alignment through wearing. The revolving part or shaft is made of phosphor-bronze, and the bearing in which this revolves is of cast iron. The stationary contacts are hardened steel, insulated from the casting by a hard fibre bushing. The brush is hardened steel, and rubs alternately against the cast-iron and steel contacts.

An oil cup located on the top provides oil for the two ends of the bearing. The manufacturer stated that it is impossible for dirt to get into the contact. There are no adjustments and no opportunity for any of the parts to get out of place.

The outside end of the contact forms the binding-post, which is of a special spring type. The end of the lever is provided with a stud for attaching the advancing rod. The hole for the shaft is made ordinarily one-half inch in diameter. This, however, can be made of any desired size. The timers are made in one-cylinder, two-cylinder, three-cylinder and four-cylinder types.



IGNITION TIMING APPARATUS.

Consolidation of Ingersoll-Sergeant Drill Company and Rand Drill Company.

The Ingersoll-Sergeant Drill Company and the Rand Drill Company, New York, have been united into a new company called the Ingersoll-Rand Company. The new corporation is formed under the laws of the state of New Jersey with a capital of $10,000,000, of which $5,000,000 is preferred and the balance common. The factories of the two companies are located at Phillipsburg, N. J.; Easton, Pa.; Tarrytown, N. Y.; Ossining, N. Y.; Painted Post, N. Y.; New York city, and Sherbrooke, Que.

The officers of the company are as follows:

President, W. L. Saunders, formerly president of the Ingersoll-Sergeant Drill Company; first vice-president, George Doubleday, formerly treasurer of the Ingersoll-Sergeant Drill Company; vice-presidents, Jaspar R. Rand, formerly president of the Rand Drill Company, John A. McCall, president of the New York Life Insurance Company, J. P. Grace, vice-president of W. R. Grace & Company, George R. Elder, general manager of the manufacturing department; treasurer, W. R. Grace, formerly secretary of the Ingersoll-Sergeant Drill Company; secretary, F. A. Brainerd, formerly treasurer of the Rand Drill Company. For the present the main offices of the new company will be located at 26 Cortlandt street, New York.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW POWER PLANT IN GRAND COUNTY, COL.—Preliminary work is being done on the construction of a power plant in Grand County, Col. A system of storage dams will be built north of Grand Lake, and a plant with a capacity of 3,000 horse-power will be constructed. Three reservoirs and dams will be built, one dam being 150 feet in height. The system is expected to furnish power for the mines in the district, and also possibly for an electric extension of the Moffat road.

MERGER OF LIGHTING COMPANIES IN PENNSYLVANIA—The electric light and railroad companies of Sunbury, Northumberland County, Pa., have been merged. The new concern is known as the Northumberland County Railway and Light Company, and is capitalized at $1,000,000. The capital is divided into 10,000 shares of the par value of $100 each. Half of the stock is preferred, and will bear five per cent cumulative dividends. The other $500,000 is common. The companies consolidated are the Edison Electric Illuminating Company and the Sunbury & Northumberland Street Railway Company. The latter company also conducted a lighting plant.

POWER PLANT TO BE BUILT IN COLORADO—The South Platte Electrical Company has been formed to build a power plant on the south fork of the Platte river. Mr. James E. Rhodes, of Denver, has for some time been working on the formation of the company. He has property rights for the location of a plant on the river a short distance from Deansbury. The canon of the river at this point will be dammed, and a water-power plant installed. It is expected that 20,000 horse-power can be generated, which will be transmitted to Denver, a distance of about twenty miles. The company has secured a franchise from the city of Denver for the supply of electric current to power consumers in that city. It is expected that the plant will be in operation in about six months.

NEW POWER COMPANY CHARTERED IN CONNECTICUT—The Uncas Power Company, of Norwich, Ct., has received a charter from the general assembly of Connecticut. The company has an authorized capital of $1,000,000, and, under certain restrictions, may distribute electricity throughout New London County. It is specially empowered to deliver electricity to the Groton & Stonington Street Railway Company and to the Norwich, Mystic & Westerly Street Railway Company. It may issue bonds to the amount of three-quarters of its full-paid outstanding capital stock. Powers of merger with other enterprises and street railway companies are conferred on the corporation. Costello Lippitt and Edwin W. Higgins, of Norwich, and Charles W. Comstock, of Mottville, are among the incorporators.

REDUCTION OF ELECTRIC LIGHTING RATES IN NEW YORK AND BROOKLYN—A reduction in the rates for electrical service has been announced by the New York Edison Company and by the Brooklyn Edison Company, both reductions to take effect on July 1, 1905. The New York Edison Company has reduced its rate from fifteen cents to ten cents per kilowatt-hour. The rate in New York includes the supply of incandescent lamps and the trimming of arc lamps. The Brooklyn Edison Company announces that the new price will be twelve cents per kilowatt-hour for lighting purposes. This price is for all current consumed, regardless of the customer's connected installation or of the average daily time during which the current is used. The schedule for power purposes is ten cents per kilowatt-hour, subject to a schedule of reductions.

ELECTRICAL NOTES FROM MEXICO—A concession has been secured by William C. Green to utilize the waters of the Aros river in the state of Chihuahua for motive power. The concession authorizes the use of 10,000 litres of water per second from the river in the vicinity of the Guaynopa mine. The concession also authorizes the construction of a pole line or the use of underground wires. Surveys for the plant must be commenced within six months, and be presented to the secretary of works within one year. Construction must be commenced within two years, and must be finished within seven years. The concession also allows the building of telegraph and telephone lines throughout the works. The capital invested will be exempt from taxation. Arrangements are being made for the transfer of the concession for the construction of an electric railway from Guadalajara to Chamela, on the Pacific coast, which was granted to M. C. Miller, of Guadalajara, to the Jalisco Rapid Transit Company. Application for a charter for the latter company is to be made in the state of South Dakota. The capital will be $15,000,000.

ELECTRIC RAILWAYS.

GAS CITY, IND.—A franchise has been granted the Marion & Hartford Street Car Company for fifty years.

BLUFFTON, IND.—The Bluffton city council has granted a franchise to the Ft. Wayne, Bluffton & Marion Traction Company.

JONESBORO, ARK.—The Jonesboro city council has awarded to N. F. Lamb a franchise for the construction of a street railway line.

MAUCH CHUNK, PA.—The Tamaqua & Lansford Street Railway Company's line will be extended through to Lehighton this summer.

NEW YORK, N. Y.—The New York & Portchester Railroad has purchased terminal property valued at $85,000 at the point where it connects with the Interborough Rapid Transit.

PARIS, ILL.—Business men of Charleston, Ill., have subscribed $20,000 toward an interurban line to connect that city with Paris, as an extension of the present Mattoon-Charleston road.

CORRY, PA.—At a council meeting C. D. Northrup, of the Corry, Findley Lake & North East trolley, accepted the city franchise and filed a bond of $2,000. Work will start immediately.

CASPER, WYO.—A movement is on foot for the formation of a syndicate to construct an electric railroad from Casper to Alcova, the site of the government dam of the Pathfinder or North Platte project.

FAIRMONT, W. VA.—The contracts for the construction work of the line to Clarksburg, which will be built by the Fairmont & Clarksburg Traction Company, have been let, as have the contracts for the line from Fairmont to Barnstown, a suburb.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has asked the board of public works for a franchise to come into Indianapolis. The petition states that the line will be completed to Danville this fall. The intention is to build to Terre Haute.

MANSFIELD, OHIO—At the annual meeting of the stockholders of the Mansfield Electric Railway and Power Company the following directors were elected: Leopold and Rudolph Kleybolte, Cincinnati; H. M. Byllesby, Chicago; A. S. Huey, Chicago, and W. D. Breed, Cincinnati.

LEWISTON, WASH.—The Lewiston city council has passed the ordinance granting a franchise to Colonel Judson Spofford and associates for the operation of an electric street railway system to be operated in connection with the independent Lewiston-Grangeville electric railway line.

WHEELING, W. VA.—The Southeastern Ohio Railway, Light and Power Company, a local company, of which Colonel C. B. Hart is the chief promoter, has awarded the contract for the building of a trolley line between Zanesville and Crooksville, Ohio. The road will cost $600,000, and is to be fifteen miles in length.

TOLEDO, OHIO—Announcement is made that the Toledo & Chicago Interurban Electric Railway Company has increased its capital stock from $500,000 to $1,250,000, and the incorporators expect there will be no delay in beginning construction operations. The company was incorporated at Indianapolis about eighteen

months ago. The system is to connect Toledo and Chicago, traversing Northern Indiana counties. F. B. Perkins, of Toledo, is the electrical engineer.

HARTFORD, CT.—It is announced that the Hartford & Springfield Street Railway Company will take over the stock of the proposed new Rockville, Broad Brook & East Windsor Street Railway Company, and will issue $100,000 six per cent preferred stock to finance the transfer. The bill granting the latter company the right to make the extension has been passed by the legislature.

KANKAKEE, ILL.—The Kankakee city council has granted a twenty-year franchise to the Kankakee & Western Electric Railway Company to construct and operate a line on Station street west to the city limits from the Illinois Central tracks and on Fifth avenue from Station street north to Court street. The franchise contains the stipulation that the line must be in operation before the end of a year.

FORT WAYNE, IND.—The city council of Decatur has amended the franchise granted the Springfield, Decatur & Fort Wayne traction line so as to make the life of the franchise fifty years instead of thirty. The Fledderjohans, who are building the line, found it impossible to finance it, unless the time was lengthened. The council made it a condition that the company bind itself to maintain its power-house in Decatur.

BOSTON, MASS.—The New York, New Haven & Hartford Railroad Company is preparing to run trolley cars over its steam railroad between Rockville and East Hartford, Ct., connecting with the Hartford Street Railway Company's tracks at Hartford, so that electric cars can be run between Hartford and Rockville. It is estimated that the time between these points will be reduced from one hour and twenty-two minutes to forty minutes.

NEWARK, N. Y.—The board of railroad commissioners of the state has granted the Newark & Marion Electric Company authority to issue first mortgage bonds for $500,000, half of which may be issued at any time and the remainder on further application for consent. A large part of the construction work of this line has been completed and it is believed that it will be put in operation on the completion of the Rochester, Syracuse & Eastern.

KALAMAZOO, MICH.—The Kalamazoo common council has granted a franchise to the Kalamazoo & South Haven interurban line. This ensures the construction of an electric line between the cities named. Work will begin at once. S. J. Dunkley, of Kalamazoo; G. E. Barden, of Otsego; the Dewings and other capitalists are largely interested. It is hoped to have much of the road completed by fall. All of the right of way has been secured.

WHEELING, W. VA.—The announcement is made that the entire line of the Wheeling Traction Company, between the creek and Forty-eighth street, is to be rebuilt, costing in the close neighborhood of $200,000. The present comparatively light rails are to be replaced by ninety-pounds-to-the-yard rails. In addition a new car house and shop will be constructed, sites for which are being sought, and fifteen double-truck cars added to the rolling stock of the road.

LAFAYETTE, IND.—Work has been begun on the extension of the lines of the Fort Wayne & Wabash Valley Traction Company from the Soldiers' Home to Battle Ground, six miles. The extension is to be completed in time for the Battle Ground camp meeting on July 27. The board of county commissioners has ceded to the company a strip about a mile long between the battlefield and the Monon railroad. It is believed that by next year the interurban will connect with Logansport *via* Monticello and Delphi.

YOUNGSTOWN, OHIO—The Cleveland & Sharon Traction Company has been taken over by Philadelphia and New York capitalists and reorganized. The road, which was completed some time ago, will be completed as soon as possible, and when opened will connect Cleveland with Sharon and Youngstown, as at Sharon connections will be made with the Youngstown & Sharon and at Middlefield with a Cleveland line. The route of the new line will include Middlefield, Prespotamia, North Bloomfield, Kinsman, Orangeville and Sharon.

MEMPHIS, TENN.—Plans for building the Nashville and Huntsville railway, an electric line projected between Nashville, Tenn., and Huntsville, Ala., are assuming definite shape. The citizens of Huntsville and Madison County, Ala., have agreed to subscribe $60,000 to the capital stock of $3,000,000, and other towns will also help. President J. H. Connor, of Nashville, president of the company, believes construction will be begun this fall. The enterprise will be financed by the Municipal Bond and Surety Company, of New York.

VALLEJO, CAL.—Prospects are said to be excellent for an early start on the work of building an electric railroad between Vallejo, Benicia Suisun and Vacaville over the route of the franchises held by J. W. Hartzell. C. F. Archer, representative of the banking house of E. H. Rollins and Sons, has inspected the route and the resources of the country, and it is stated on good authority that upon his recommendation the banking house is now negotiating with a large eastern construction firm to take the contract for this line.

CHEYENNE, WYO.—Judge John Porter, owner of a street car line in Des Moines, Iowa, who went West to bid on the construction of the North Platte canal of the government, has offered to construct an electric street railway in Cheyenne at a cost of $100,000 if local business men will subscribe to 50,000 of the stock of a stock company to be formed. If suitable power can not be obtained from the Warren Electric Light Company at Cheyenne Mr. Porter will construct an independent power-house. The line will traverse the principal streets of the city and extend to Fort Russell.

LAPORTE, IND.—The South Bend Western Railway Company, which is the name under which the Indiana Railway Company will construct an interurban line from South Bend to Laporte, through New Carlisle and Rolling Prairie, has been formed. Articles of incorporation give the capital stock as $100,000. The officers are William L. Taylor, of Indianapolis, president; Mortimer H. Reed, of South Bend, second vice-president; W. W. Babcock, of South Bend, secretary, and Charles Lohman, of South Bend, formerly of Indianapolis, treasurer, with Fred W. Bueltzinslowen an additional director.

BALTIMORE, MD.—The Baltimore Terminal Company has asked permission of the Baltimore city council to construct and maintain what is intended to be the Baltimore end of the Washington, Baltimore & Annapolis Railway Company, which will link the three cities named. It is proposed to build a double-track road and to run cars at fifteen-minute intervals, making the trip between Baltimore and Washington in one hour. George T. Bishop, of Cleveland, Ohio, is president of the company, which is largely backed by western capital. Terminal rights have already been secured in Washington and Annapolis, it is said.

LEGAL NOTE.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY LITIGATION—In the United States Circuit Court of Appeals for the Third District, on an appeal by the Jefferson Electric Light, Heat and Power Company from the decision of the Circuit Court of the United States for the Western District of Pennsylvania, the court has overruled the plea of the appellant and affirmed the decree of the lower court, granting a preliminary injunction. The same court, under date of June 14, in the case of the Westinghouse Electric and Manufacturing Company, complainant-appellant, *vs.* the Stanley Instrument Company, defendant-appellee, denies the petition filed by the Stanley company on December 7, 1904, for leave to apply to the Circuit Court for leave to file a supplementary bill in the nature of a bill of review, or to amend the judgment on appeal.

NEW MANUFACTURING COMPANIES.

COLUMBUS, CHIO—The William Hall Electric Company has been incorporated by William Hall, Charles S. Hall, William Nichols, J. Edward Sallenberger and James A. Rickey. The capital is $18,000.

RICHMOND, VA.—Articles have been signed incorporating the Seaboard Electric Company. The incorporators are Arthur L. Bosley and Harry E. Karr, of Baltimore; Julien Binford, Jr., and William S. P. Mayo, of Richmond; J. W. Little, of Atlanta, and Thomas W. Dunk, of Jacksonville. The authorized capital stock of the new company is $50,000, and its purpose is to deal in electrical apparatus and supplies of every kind.

PERSONAL MENTION.

MR. JOHN MACK, who has been president of the Municipal Telephone and Stock Company, Albany, N. Y., has retired from that corporation.

MR. H. C. EDDY, electrical inspector in Washington, D. C., has tendered his resignation to the district commissioners. The resignation took effect June 15. Mr. Eddy has accepted a position with an engineering and contracting firm in New York.

MR. M. K. EYRE has been placed in charge of the factory of the Sawyer-Man Electric Company, New York city. Mr. Eyre has for a long time been connected with the incandescent lamp industry, and has taken a prominent part in the development of this apparatus. Mr. Eyre was graduated from Annapolis, resigning from the navy in 1894 to go into the electrical business. He became assistant to the manager of lamp sales of the General Electric Company, and in 1895 was appointed superintendent of the Edison lamp works at Harrison, N. J. In the latter part of 1895 he was made manager of works. He was a member of the manufacturing committee of the General Electric Company. In 1900 he became associated with the National Electric Lamp Company, having charge of the Fostoria plant, afterward becoming chairman of the manufacturing committee of the National Electric Lamp Company. He later became president of the Buckeye Electric Company. Mr. Eyre has been very successful in all of his connections with the above companies. His work has been particularly along the line of improving the product of the lamp factory and instituting shop economies which have resulted in a material reduction in the cost of lamp apparatus.

MR. M. K. EYRE.

MR. CHARLES E. SCHOLZ has taken charge of the filament department of the Sawyer-Man Electric Company, New York city. Mr. Scholz was graduated from the technological school at Stralsund, Germany, and spent about four years in commercial business before coming to the United States in 1879. In 1885 he engaged with the Schaeffor Company, Cambridge, Mass., in the manufacture of silk and bamboo filament. About that time Mr. Scholz and a Mr. Flock, a well-known lamp man of that time, began experimenting on cellulose, using different minerals to dissolve the raw material, achieving considerable success in producing a fine fibre. Owing to not having facilities for carbonizing this fibre, the product was given up for the time being. In 1892 the company located in Marlboro, Mass. Shortly after the Bryan-Marsh Company bought the factory to manufacture its own cellulose filaments. Mr. Scholz was placed in charge of the filament plant. This was successful from the start, the Marlboro plant not only supplying its own demand, but also the demand of other lamp factories for filaments.

MR. CHARLES E. SCHOLZ.

MR. FRANK C. RANDALL has joined the Allis-Chalmers Company as district manager for the district of New York, with headquarters in New York city, resigning as vice-president and general manager of the National Electric Company. Mr. Randall has been closely identified for years with the street railway supply interests. His business career began in Boston in the office of his father, who was an importer of special grades of iron and steel. After a few years' experience he took up railroading, becoming first "the performance of engines" clerk, and later chief clerk of the motive department for all divisions west of Willimantic of the New York & New England Railroad. He was afterward chief clerk of the motive department of the Boston & Lowell road, and held this position until the consolidation of the road with the Boston & Maine Railroad. After this he entered the shops of the Tripp Manufacturing Company, becoming expert in the manufacture of electric railway car trucks. He rose to the place of foreman, and later to that of superintendent of the works. He left this position to become eastern sales agent for the J. G. Brill Company, and later was transferred to the West, with headquarters in Chicago. Six years later he accepted the position of eastern sales agent for the Christensen Engineering Company, afterward becoming general sales agent for that company and its successor, the National Electric Company. He then became vice-president and general manager.

MR. FRANK C. RANDALL.

ELECTRICAL SECURITIES.

Although it was frequently predicted that the opening of peace negotiations, the settlement of the life insurance scandal, and the demand by many influential persons that an immediate return be made to old-fashioned, wholesome methods of financiering, would result in a prompt stimulation of stock market activities, the last week's session was probably as dull as has ever been witnessed in recent years. Following a very weak rally in the early part of the week, prices declined to what may be considered, for many securities, the low level of the year. While the present outlook shows little to be expected in the way of activity, the large operators having almost entirely abandoned speculation for the time being, the very fact that there is a condition of slumbering may lead to some rapid manipulation which will considerably change the face of things in a very short period of time. It is to be expected, however, that during the heated period there will not be any very great activity. Attention is now being turned more than ever to the prospects of crop returns, and there apparently is the assurance at hand that the conditions are such as to cause no anxiety, reports from all quarters indicating that all growing things are making the progress that can be expected at this time of the year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 17.

New York:	*Closing.*
Brooklyn Rapid Transit	63⅞
Consolidated Gas	186
General Electric	174
Interborough Rapid Transit	201
Kings County Electric	200
Manhattan Elevated	161¾
Metropolitan Street Railway	122½
New York & New Jersey Telephone	169
Westinghouse Manufacturing Company	180

The regular quarterly dividend of 1¼ per cent is payable July 15 to stockholders of record of the Western Union Telegraph Company as of June 20.

Boston:	*Closing.*
American Telephone and Telegraph	140¼
Edison Electric Illuminating	243
Massachusetts Electric	61¼
New England Telephone	139
Western Telephone and Telegraph preferred	98

American Telephone and Telegraph directors have declared the regular quarterly dividend of 1½ per cent and an extra dividend of ¾ of one per cent, payable July 15. Books close June 30 and reopen July 15.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	78
Electric Storage Battery preferred	78
Philadelphia Electric	8½
Philadelphia Rapid Transit	25¾
United Gas Improvement	92½

The directors of the United Gas Improvement Company have declared the regular quarterly dividend of 2 per cent, payable July 15 to stock of record June 30.

Chicago:	*Closing.*
Chicago Telephone	136
Chicago Edison Light	158½
Metropolitan Elevated preferred	64
National Carbon common	62
National Carbon preferred	116
Union Traction common	6
Union Traction preferred	32

At the annual meeting of the Chicago Edison Company officers and directors were reelected.

NEW INCORPORATIONS.

LANSING, MICH.—American Electric Company. $2,000.

MESSENA, IOWA—Messena Telephone Company. $10,000.

JEFFERSONVILLE, IND.—Independent Telephone Company. $500.

PEORIA, ILL.—Central Railway Company. Increased from $1,040,000 to $1,250,000.

MONTREAL, QUE.—Bell Telephone Company, of Canada. Increased from $8,000,000 to $9,000,000.

ALBANY, N. Y.—The Depew & Lancaster Light, Power and Conduit Company. Increased from $75,000 to $500,000.

DES MOINES, IOWA—Valley Junction Water and Light Company. $12,000. Incorporators: John Fisher and others.

AUSTIN, TEX.—Columbus Light Company, of Columbus. $10,000. Incorporators: J. W. Towell, Carey and Josiah Shaw.

BUFFALO, N. Y.—The Alden Lighting, Heat and Power Company. $200,000. Directors: Frederick G. Bagley, Alfred L. Becker and D. E. Klein.

OLEAN, N. Y.—Natural Gas, Electric Light, Heat and Power Company, Olean. $50,000. Directors: W. R. Page, F. R. Easton, J. L. Page, Olean.

SPRINGFIELD, ILL.—Home Electric Light and Power Company, Rock Island. $10,000. Incorporators: Robert W. Olmsted, R. S. Dart, E. H. Stafford.

NEW CASTLE, PA.—The Western Pennsylvania Motor Power Company. To build trolley lines in Mercer, Lawrence, Beaver and Butler counties. $10,000.

BUFFALO, N. Y.—The Southern Tier Power and Transmission Company. $200,000. Directors: H. Merton Merrihew, Harrison Williams and Herbert A. Taylor.

NASHVILLE, TENN.—Lenoir City Light and Power Company. $2,500. Incorporators: William Glass, R. M. Calloway, G. W. Strausberry, J. A. Nelson and J. E. Calloway.

JOHNSTOWN, N. Y.—Sacandaga Power Company. $6,000. Directors: William Harris, of Northville; George N. Ostrander, of Albany, and John A. Cole, of Northville.

ALBANY, N. Y.—The Empire State Gas and Electric Light Company, New Rochelle. $50,000. Directors: W. H. Cooper, N. R. Fox, New Rochelle; C. J. Van Slyke, New York.

SAN FRANCISCO, CAL.—The Oceanside Electric Light Company. $20,000. Incorporators: R. H. Fitzgerald, J. T. Boyd, Henry B. Young, J. H. Brenner and J. D. McGown.

LANSING, MICH.—Michigan, Indiana & Ohio Railroad Company, Monroe. To build an electric railway line from Petersburg to Monroe, a distance of five miles. $50,000.

GUTHRIE, OKLA.—Fairview Telephone Company, of Orlando. To operate in Payne and Noble counties. $540. Directors: Wm. D. Gish, Robert Grant and John L. Winkler, of Orlando.

DES MOINES, IOWA—The Valley Junction Water and Light Company. $12,000. Directors: John Fisher, A. H. Van Dyke, John and T. H. Ashworth, all residents of Valley Junction.

MINETTO, N. Y.—Minetto Light, Heat and Power Company. $20,000. Incorporators: Cadwell B. Benson, Minetto, Oswego County; Theodore A. Page, G. Leonard Johnson, Oswego, Oswego County.

MOUNT VERNON, N. Y.—Mount Vernon Telephone Company. To operate telephone lines. $5,000. President, C. W. Mansur; treasurer, R. W. Leighton; clerk, R. W. Leighton; all of Mount Vernon.

BATAVIA, N. Y.—The Genesee County Electric Light, Power and Gas Company, of Batavia. $100,000. Directors: Raymond M. Walker and C. C. Bradley, of Batavia, and Simond B. Storer, of Syracuse.

BINGHAMTON, N. Y.—Tracy Creek Telephone Company. To operate a line from Tracy Creek to Vestal Center, Willow Point, Vestal and back to Tracy Creek, *via* the river road, and also from Tracy Creek to Apalachin, Tioga County. $10,000. Directors: L. A. Mason, George Morton, Alex Webster, B. C. Plough, Fred Wood, F. D. Brummer, Orrin Knight, all of Tracy Creek.

GUTHRIE, OKLA.—Oklahoma Northern Mutual Telephone Company, of Grant County. $1,000. Incorporators: J. W. Thompson, president; C. E. Tibbits, secretary; A. C. Treat, treasurer, all of Hunnewell, Kan.

TOPEKA, KAN.—Jasper County Light and Fuel Company, Pittsburg, Pa.; $25,000. Western Rural Telephone Company, Harper; $600. Glenridge Mutual Telephone Company, St. John; $1,200. Lawrence Electric Light Company, Lawrence; $40,000.

JERSEY CITY, N. J.—Sioux City Service Company. To manufacture, generate and supply electricity and other mechanical power for light, heat, etc. $250,000. Incorporators: Louis B. Dailey, Thomas F. Barrett, B. Stafford Mantz, all of Jersey City.

ALBANY, N. Y.—Upper Hudson Electric and Railroad Company, Newburgh. To operate an electric road twenty-five miles long, from Albany to the village of Catskill. $500,000. Directors: Luke F. Gillespie, Newburgh; Eugene Wolfe, Athens; F. J. Curnick, New York.

PEORIA, ILL.—Central Illinois Interurban Railroad Company. To build a line from Peoria, through Pekin, Havana, Mason City, Springfield, to Lincoln and intermediate points. $5,000. Incorporators: John B. Abbott, Fritz Hendahl, Cande Stone, Paul Enlows, Athos King.

PEKIN, ILL.—Peoria, Pekin & Bloomington Interurban Railway, of Illinois. $100,000. Incorporators: F. E. Seagrave, Toledo, Ohio; Deloss S. Brown, Peoria; Levi Johnson, Danvers, Ill.; Judge Jesse Black, Wm. A. Potts, Walter E. Lautz, Pekin, and E. H. Roberts, of Washington.

RALEIGH, N. C.—The South Atlantic Terminal Company. To construct a railroad from Wilmington to Southport, twenty-seven miles. $1,000,000. Incorporators: D. M. Dougherty, New York; D. W. Bullock, W. J. Bellamy, George L. Morton, C. T. Bennett and J. H. Winston, Wilmington.

AUGUSTA, ME.—Central Railroad of Oregon. Organized at Augusta for the purpose of acquiring, constructing, maintaining and operating a line of railway and telegraph and telephone lines in connection therewith, etc. $2,000,000. Officers: president, J. Berry, of Augusta; treasurer, I. L. Fairbanks, of Augusta.

CARLINSVILLE, ILL.—St. Louis, Litchfield & Eastern Railroad Company. $5,000. Incorporators: J. H. Belt, Jr., president, Bunker Hill; J. E. Kelsey, vice-president, Bethalto; H. R. Budd, secretary, Bunker Hill; C. E. Drew, treasurer, Bunker Hill; W. P. Dickie, Bunker Hill; George A. Klein, Bethalto; A. R. Stansifer, Litchfield.

INDIANAPOLIS, IND.—South Bend Western Railroad Company. To build an electric line to Laporte and absorb the Chicago & South Shore line now operating between Laporte and Michigan City. $100,000. Officers: W. L. Taylor, president; M. P. Reed, vice-president; W. W. Babcock, secretary, and C. G. Lohman, treasurer.

OKLAHOMA CITY, OKLA.—Oklahoma Traction Company. To construct an electric railway line from Oklahoma City to Lexington, Cleveland County, a distance of forty miles. $300,000. Incorporators: C. E. V. Eggleston and S. G. Glasgrow, of Oklahoma City; C. R. Eggleston, of Ft. Smith, Ark.; L. E. Patterson, of Ada, I. T., and L. D. S. Woodson, of Alva.

JEFFERSON CITY, MO.—Oran Electric Railway Company, of Oran. To build an electric road ten miles in length, running from Oran to Rockview, the entire line to be within Scott County. $50,000. Incorporators: M. G. Gresham, George Albert, F. D. Cooksy, P. P. Marshall, M. Q. Tanner, J. T. Gittens, W. H. Stubblefield, Jr., W. H. Westcott, Caleb Matthews and M. Helmbacher.

ALBANY, N. Y.—The Jefferson County Gas and Electric Company, of Watertown; $100,000; directors: J. B. Taylor, F. B. Pitcher, B. J. McCarthy, of Watertown. The Otsego Transmission Company, of Oneonta; $40,000; directors: John D. Capron, of Menands; William W. Capron and William H. Smith, of Oneonta. Castleton Light, Heat and Power Company, Castleton; to operate in Schodack, Castleton, East Greenbush and Rensselaer; $25,000; directors: J. D. Smith, T. F. Clifford, F. H. McKnight, of Castleton.

TELEPHONE AND TELEGRAPH.

BEVERLY, OHIO—The Farmers' Telephone Company has established a new exchange at Waterford.

ROYALTON, N. Y.—The Bell Telephone Company is making preparations to extend its line from Terry's to Royalton Centre.

TROY, N. Y.—The Hudson River Telephone Company has purchased the business of the Fort Miller Telephone Company, and is extending its lines to Fort Miller.

FLUSHING, N. Y.—A farmers' telephone line will be erected from Palm to Clayton, and in Douglass township a large number of farmers will build a local line.

SHERMAN, TEX.—All indications now point to the early completion of a long-distance telephone connection between Sherman and Gainesville by the independent company.

ST. JOHNSVILLE, N. Y.—The Interstate Telephone Company is about to begin the construction of a rural line from Indian Castle to Fort Plain, *via* the Dutchtown or Fort Willett road.

LENA, WIS.—The Bell Telephone Company has sold its line from Pound to Coleman to the Farmers and Merchants' Telephone Company, of Lena. This gives Lena and Coleman direct communication with Pound.

KANSAS CITY, MO.—The Missouri & Kansas (Bell) Telephone Company has taken out a permit in Kansas City, Kan., for a $3,000 addition to its West office at Sixth street and Armstrong avenue, in that city. The switchboard will be extended the entire length of the new building.

BALDWINSVILLE, N. Y.—The local telephone line extending from Jordan to Baldwinsville is nearly completed, the poles being set to the corporation line. This line will establish connection with the farmers residing at Cross Lake and Plainville. At Baldwinsville connection will be made with the Bell Telephone Company and also the Syracuse & Baldwinsville line.

SIOUX CITY, IOWA—Work has been begun on the construction of the first of the New State Telephone Company's copper toll lines in Sioux City, this being the line connecting Sioux City with LeMars. At LeMars the line will open up a field of several hundred towns in northwestern Iowa, and several thousand telephones to be given connection with Sioux City under the new independent system.

SAN DIEGO, CAL.—Officials of the Home Telephone Company state that construction of lines at Coronado and National City, where applications for franchises have already been made, will commence as soon as material arrives from the east. Long-distance communication with the north by extension from Santa Ana is also to be established, the poles for the lines having already been ordered.

LOS ANGELES, CAL.—The Home Telephone Company, of Los Angeles, which, according to report, is to extend its operations to San Francisco and Oakland, has issued its annual report, in which it is set forth that the surplus after paying operating expenses, interest on bonds and dividends for 1904 is $50,603.27. During this time dividends amounting to over $75,000 were paid on the stock of the corporation.

CANANDAIGUA, N. Y.—The People's Telephone Company, of Ontario County, held its annual meeting recently, and these officers were elected: president, H. W. Blake, Naples; vice-president and general manager, John Litzendorf, Honeoye; secretary, George B. Hemenway, Naples; treasurer, G. R. Granby, Naples; directors, D. O. Pierpont, of Richmond; E. Chapin Church, of Canandaigua and R. B. Abbey, of Richmond.

OLATHE, KAN.—Oscar O. Ayers has sold to F. R. Ogg, an attorney of Olathe, and M. G. Miller, owner of the Bank of Olathe, the Citizens' Telephone Company for $35,000. The Citizens' Telephone Company was organized about five years ago, with Harry B. Walker, of Kansas City, Mo., as its president. Walker sold to Ayers about one year ago for $20,000. Ayers has extended the line and now has 800 telephones in service.

ALBANY, N. Y.—During the current year the Hudson River Telephone Company shows a net gain in stations of nearly 4,000, and the figures at present indicate that the net gain in Albany will be fully a thousand stations before the end of the year, while for the company's entire territory the increase will be more than 8,000. New buildings are being pushed to completion by the company at Saratoga, Newburgh, Rensselaer, Plattsburg, Sandy Hill and Peekskill. It is expected that all will be finished by the early fall.

NASHVILLE, TENN.—As a result of several conferences between the auditors of the Cumberland Telephone and Telegraph Company and the city council committee a reduction of telephone rates is announced. The present monthly rate on business telephones is $7 within a radius of one mile, with $1 for each additional mile; two on party line, $5, and $1 added. The $1 additional will be abrogated under the new schedule and limited call service telephone at $4 per month straight will be added. The present rate on residence telephones is $4, with $1 added for each mile over one. This rate is reduced to $3 flat, and $2.25 for two-party lines, and $2 for four-party lines. The rates apply to all of Greater Nashville. The city is to secure a rate thirty per cent less than the rate charged private parties.

ELECTRIC LIGHTING.

NASHVILLE, TENN.—The Nashville Railway and Light Company has secured a permit to erect a $25,000 power-house addition.

AUBURN, ME.—The Lewiston & Auburn Electric Light Company has been awarded the contract for street lighting in Auburn.

WINSLOW, ARIZ.—Winslow has voted a franchise for an electric light and power plant, and the machinery will be installed at once.

GALION, OHIO—The Crawford Gas and Electric Company has purchased the electric light plant at Crestline, from the Crestline Illuminating Company.

FLORENCE, N. J.—At a recent town meeting an appropriation of $1,925 for lighting the streets was passed. Commissioners were elected to arrange plans.

RUSHFORD, MINN.—A company has been formed to utilize the water power of Root river. It proposes to furnish electric light and power for the manufacturing plants of Rushford.

PITTSTON, PA.—Thomas Dunn, of Wilkesbarre, is forming a new electric light company in Pittston, to supply the city and near-by towns. The company is to be capitalized at $100,000, of which $35,000 has already been subscribed.

KALAMAZOO, MICH.—The Creston Mutual Electric Light, Heat and Power Company has organized with the following officers: president, J. C. Sullivan; vice-president, C. S. Rice; secretary, J. W. Reynolds; treasurer, John Hackett.

VERGENNES, VT.—The Bristol Electric Company has been absorbed by the Lake Dunmore Power and Traction Company. The latter company plans to put two dams in the New Haven river. It also plans to install an auxiliary steam plant. The village of Bristol has authorized the trustees to make a five-year contract with the company for street lights.

CONCORD, N. H.—The contract for enlarging the canal and making the excavation for the addition to the power station of the Concord Electric Company, at Sewalls Falls, has been awarded to Holbrook, Cabot & Rollins, of Boston. The contract for the power-house and equipment is yet to be awarded. The cost of the improvements to be made will aggregate $125,000.

NIAGARA FALLS, N. Y.—The stockholders of the Canadian Niagara Power Company have elected the following directors: W. H. Beatty, W. B. Rankine, A. Monro Grier, K. C., W. H. Brouse and Wallace Nesbit. Officers were elected as follows: president, W. H. Beatty; first vice-president and treasurer, W. B. Rankine; second vice-president and secretary, A. Monro Grier; assistant secretary and treasurer, W. Paxton Little.

CHARLESTON, S. C.—The Charleston Light and Water Company has elected as directors for the ensuing year: P. H. Gadsden, W. C. Miller, W. E. Huger, A. H. S. Post, of Baltimore; G. W. Williams, Morris Israel, and J. S. Keen, Jr., of Philadelphia. At the meeting of the directors, held afterward, the following officers were elected: president, A. H. S. Post; vice-president, P. H. Gadsden; secretary, J. M. Divens; treasurer, Zimmerman Davis.

INDUSTRIAL ITEMS.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., will be pleased to send bulletin No. 92, descriptive of the two-plate type chloride accumulator.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., reports a continuance of brisk trade in its "Sunbeam" lamps, the sale of these lamps for this season of the year being unusually large.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is distributing an attractive series of literature calling attention to its National Code fuseless cleat rosettes, porcelain fixture sockets and sign receptacles.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., is distributing bulletin No. 1 describing the installation of unit accumulators in the central exchange of the Frontier Telephone Company, of Buffalo, N. Y.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., is distributing bulletins No. 145 and No. 146, describing respectively the S. K. C. type B. O. lighting transformers and a new line of polyphase induction motors.

THE W. E. CALDWELL COMPANY, INCORPORATED, Louisville, Ky., manufactures all kinds of tanks, towers and tubs. The company is calling attention to its products in a thirty-six-page catalogue, which contains a large amount of valuable information.

G. M. GEST, the expert subway contractor, New York and Cincinnati, has been awarded the contract for the construction of a complete underground conduit system for the Montreal Light, Heat and Power Company, Montreal, Canada. Over 1,000,000 feet of conduit will be used.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has issued a catalogue, describing the various types of lifting magnets manufactured by it. A number of different magnets are illustrated, and the various uses to which they may be put are shown.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has issued two attractive catalogues descriptive of the Moloney high-grade transformers. The construction and performance of these transformers are fully described in these catalogues, which the company will be pleased to send upon request.

THE ELECTRIC COMPANY, Continental Building, Baltimore, Md., has published an attractive booklet entitled "Notes on Electric Service." This comprises a number of verses under the heading "The Tale of the Merry Zephyrs," which introduces to the reader the utility of various forms of electric fan apparatus.

THE F. BISSELL COMPANY, Toledo, Ohio, has shipped to the Van Wert-Fort Wayne extension of the Fort Wayne, Van Wert & Lima Traction Company an order of 2,000 forty-foot seven-inch poles. The company has also filled large orders for Idaho poles at Fort Wayne and Middletown, Ind., and Hamilton and Findlay, Ohio.

THE WHITE SEWING MACHINE COMPANY, Cleveland, Ohio, has issued the *White Bulletin* No. 9, describing the White steam carriage. The bulletin contains a number of interesting articles, among which may be mentioned one entitled "Touring from Savannah to Buffalo," and one entitled "An Impromptu Trip from New York to Chicago."

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., in bulletin No. 44, describes and illustrates representative applications of its back-geared motor to industrial plant service. This is a compact, self-contained device which accomplishes slow speed without the necessity of employing motors designed for slow armature speeds.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Mt. Branch, Pa.; Berwick, Pa.; Fulton, Kan.; Fenton, Iowa; Bowbells, N. D.; Folsondale, Ky.; East Smithfield, Pa.; Elizabeth, N. C.; Washington, N. C.; Oranville, N. D.; Pontiac, Ill.; Macon, Ill.; Chicago, Ill.; Fulton, Iowa.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., in circular No. 13 and circular No. 14, describes, respectively, individual motor-driven machines and the "Interpole" variable-speed motor. The company is rapidly increasing the scope of application of "Interpole" variable-speed motors, and these bulletins present some very interesting matter concerning the characteristics and performance of this apparatus.

THE NEWTON MACHINE TOOL WORKS, INCORPORATED, Philadelphia, Pa., has issued catalogue No. 41, describing the rotary planing machine built by it. The catalogue takes up a number of machines varying in size from twenty-six inches to ninety-six inches, and also a number of special machines, including vertical spindle rotary planing machines, roll-cutting machines, slabbing machines and cold saw cutting-off machines.

THE PRATT & WHITNEY COMPANY, Hartford, Ct., is calling attention to its new twelve by forty-eight thread-milling machine. This is being done by means of a unique mailing card, which is made in the form of a shallow box. The cover of this box may be lifted, exposing a folder upon which is delineated some of the work done by this machine. The company claims that the machine will mill spiral gears, worm threads, screw threads, etc., quicker and more cheaply than they can be made on a lathe.

THE CENTURY ELECTRIC COMPANY, St. Louis, Mo., announces that it is enjoying large sales of its single-phase, self-starting motors. During the month of May, 1905, the sales exceeded the total sales for the year 1904. The motors are built in sizes of one-half to five horse-power, sixty cycles, but are also wound for any other commercial frequency. The company also reports a heavy increase in the demand for its alternating-current ceiling fans, the factory being at present taxed to supply the demand.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, has issued a book entitled "A Treatise on Tool Room Grinding and Grinding Machines." The book consists of two parts, treating, respectively, of the No. 1 "Cincinnati" universal cutter and tool grinder, and the No. 2 "Cincinnati" universal cutter and tool grinder. The book contains descriptions and illustrations of the various machines built, together with illustrations of the work done by them, and directions for their operation.

THE ELECTRICAL TESTING LABORATORIES, Eightieth street and East End avenue, New York city, is distributing a booklet descriptive of standard lamps used as secondary standards of candle-power. The Electrical Testing Laboratories has issued about 1,000 lamps for use as secondary standards of luminous intensity. These lamps are in the hands of colleges, consulting electrical engineers, lighting companies, lamp manufacturers and photometrists in general. They include standards ranging from miniature lamps to 150-candle-power lamps, and have given universal satisfaction.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago, Ill., has issued a treatise on the use of sulphate of iron and copper in water purification. This is a subject which has recently attracted a great deal of attention, the remarkable success which has been attained by the use of sulphate of iron and copper in water purification and in reducing the liability of typhoid epidemics having occasioned a great many tests by eminent scientists and physiologists. The treatise contains the reports of the United States government experts on experiments conducted at Anderson, Ind., in February, 1905.

THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ontario, will equip the Windsor & Tecumseh Electric Railway with 300-kilowatt, 3,300-volt Westinghouse single-phase, engine-type generators direct-connected to Robb-Armstrong engines. The car equipments will consist of two fifty-horse-power Westinghouse single-phase motors each. This will be the first single-phase road in Canada, and its development will be watched with considerable interest. The Chatham, Wallaceburg & Lake Erie Railroad Company is building a new line from Chatham to Wallaceburg, a distance of about twenty miles. The Canadian Westinghouse Company, Limited, will also furnish the material for this road, having received an order for four double equipments and one quadruple equipment of No. 101 railway motors. Another contract received by the Westinghouse company is that for furnishing two 6,400-kilowatt, three-phase, 2,400-volt generators with motor-driven exciters and switchboard apparatus, and four 3,200-kilowatt, oil-insulated, water-cooled, step-up transformers for the Hamilton Cataract Power, Light and Traction Company, for additions to its power plant at De Cew Falls.

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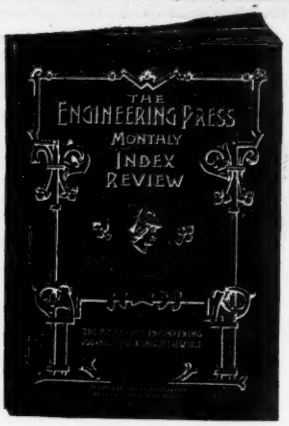

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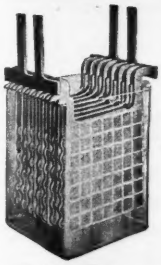

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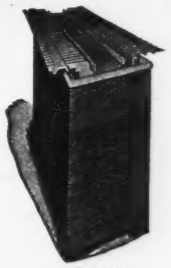

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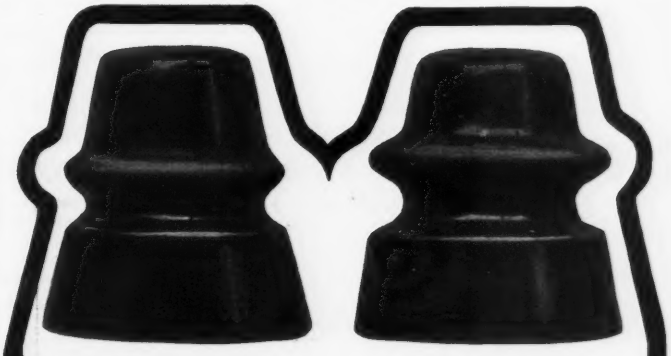

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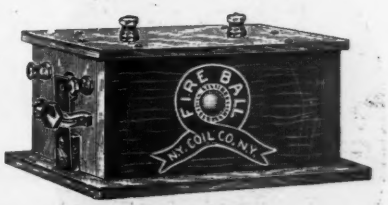

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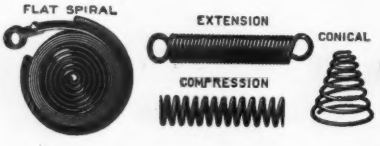

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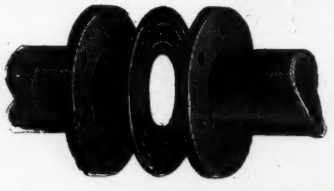

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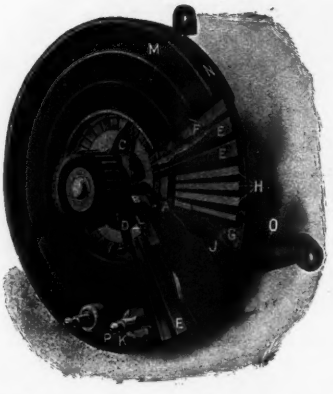

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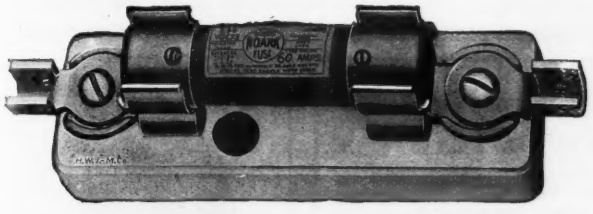

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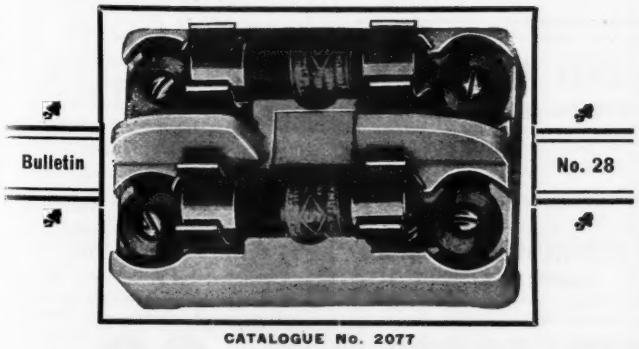

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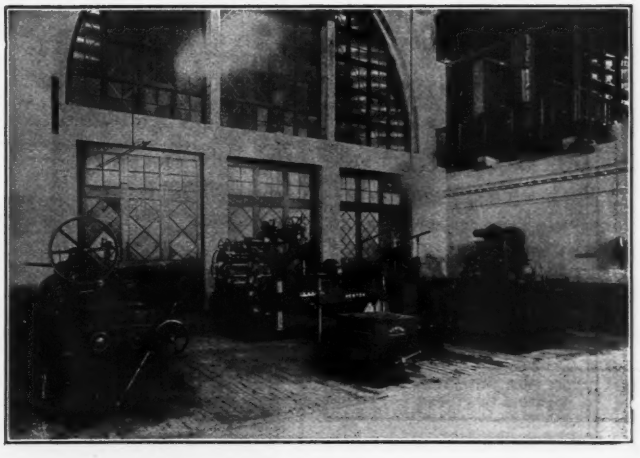

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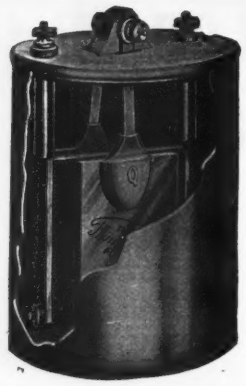

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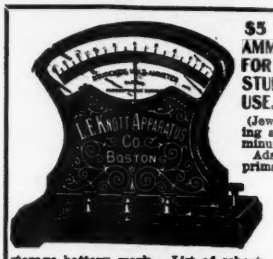

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.....	D. C. Series Constant Current Arc Lamps "L 5"	
.....	A. C. Multiple, 60 to 133 Cycle Arc Lamps "L 6"	
.....	A. C. Arc Lamps "L 7" Series Shuntwound	
.....	A. C. Differential Arc Lamps "L 8" Series	
.....	D. C. Multiple, 200 to 250 V. Arc Lamps "L 12"	
.....	D. C. Multiple, 100 to 125 V. Lamps "L 11" and "L 21"	
.....	D. C. Multiple, 100 to 125, 200 to 250 V., Types "L31", "L41", "L22" Arc Lamps	
.....	Catalogue of Parts of Types "L 11" and "L 21" Arc Lamps	
.....	Concentric Arc Light Diffuser Outfits	
.....	Hanger Board for Multiple Arc Lamps	
.....	Combined Hanger and Absolute Cutouts	
.....	New Trimming Device for High Tension G. I. Arc Lamps	
.....	Carbons for Enclosed Arc Lamps "Electra"	
.....	G. I. Incandescent Lamps	
.....	"Zodiac" Incandescent Lamps	
.....	Open Bottom Globes	
.....	Automatic Switches	G. I. Pink Catalogue — Switchboard Appliances
.....	Knife Switches, Slow and Quick Break	
.....	G. I. Type 2 Knife Switches	
.....	Oil Switches and High Tension Apparatus	
.....	Stab Switches, for Series Arc or Incandescent Circuits	
.....	Voltmeter and Ammeter Switches	
.....	Circuit Breakers, Under and Overload	
.....	Circuit Breakers, Special Small Sizes (Type C. B.)	
.....	Protective Fuse Devices	
.....	S. K. C. Instruments	
.....	Portable and Small Pocket Type Voltmeters and Ammeters	
.....	Round Pattern Voltmeters and Ammeters	
.....	Lightning Arresters	
.....	Primary Fuse Box, Insulator Type	G. I. Buff Catalogue — Wiring and General Appliances
.....	Floor Outlet Boxes (Water-Tight)	
.....	Flush Receptacles and Plugs	
.....	Flush Wall Pocket Receptacles	
.....	Flush Push Button Switches	
.....	Pendant Push Button	
.....	Snap Switches	
.....	Punched Clip Knife Switches	
.....	Transformer, Type Z	
.....	Rheostats and Field Regulators	G. I. Yellow Catalogue — Motors and Generators
.....	D. C. Motors and Generators	
.....	A. C. Small Motors	
.....	Grinding and Buffing Motors	
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.....	D. C. and A. C. Sewing Machine Transmitters	
.....	D. C. Desk Bracket and Trunnion Fan Motors	
.....	D. C. Ceiling Fans	
.....	General Instruction Bulletin Paragon Motors	
.....	Small Plant Switch Panels	G. I. Blue Catalogue — Panels
.....	Plug Panel Boards	
.....	G. I. Panel Boards and Fuse Carriers	
.....	Wright Discount Indicator	G. I. Green Catalogue — Miscellaneous
.....	Blue Printing Outfit	
.....	Underground Apparatus	

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529 WEST 34th STREET NEW YORK CITY

Information and Data on any item checked would be appreciated.

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is the result of exhaustive tests and experiments.

TIME has proven them to be the most perfect in regulation.

Most economical.

Most reliable in operation.

Lowest maintenance cost.

And the simplest arc lamp now on the market.

Full information is contained in our new catalogue. 2

THE ADAMS-BAGNALL ELECTRIC Co.

CLEVELAND, O. Branches in Principal Cities

ARC BURST

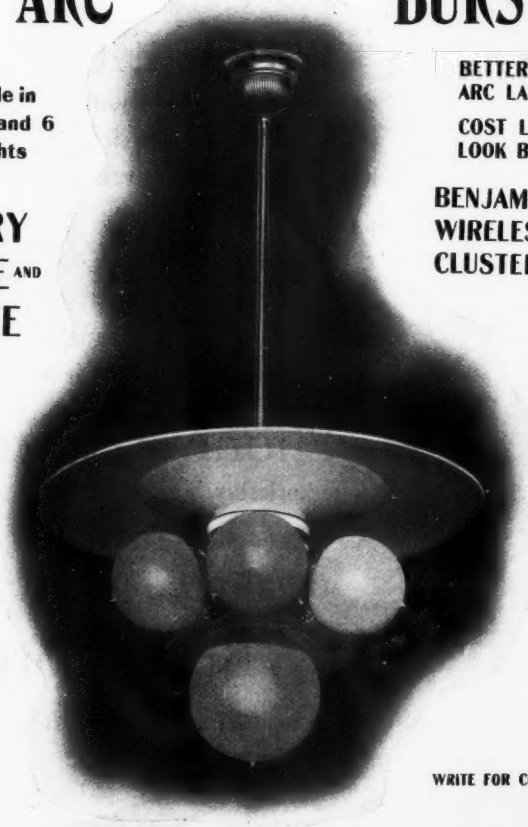
Made in 4, 5 and 6 Lights

TRY ONE AND SEE

BETTER THAN ARC LAMPS

COST LESS LOOK BETTER

BENJAMIN WIRELESS CLUSTERS



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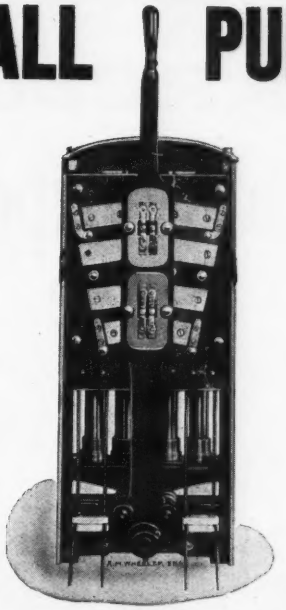
RHEOSTATS
FOR ALL PURPOSES

No Steps or Segments.
Sparking, Flashing and
Burnouts Impossible



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Fully Guaranteed
Ask Your Engineer About
It. He ought to know.

Write To-Day

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NO REPAIRS
PERFECT CONTROL
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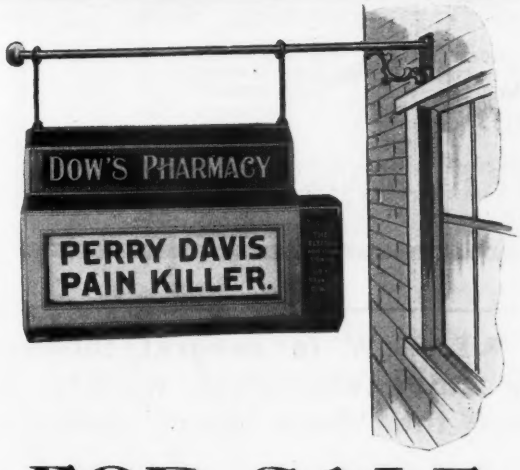

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STATE RIGHTS

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WHY NOT MAKE YOUR OWN SIGNS?
AND SAVE FREIGHT

They afford a splendid opportunity for money making, as the advertising spaces are sold on a rental basis. The margin of profit is very large. If you are interested in a money-making proposition write us and we will lay our plans before you.

The Electric Advertising Sign Company
119 EAST FRONT STREET, - CINCINNATI, OHIO

This is not the kind of a FLASHER we make, but those who use our RECO FLASHERS can wear a FLASHER like the above

We want every electrical dealer, contractor and central station manager to know about this new and remarkable sign flasher.

It is built for work of ten amperes and up. It is simple, self-lubricating, strong and serviceable. It has many remarkably fine points.

BIG PROFITS TO DEALERS AND CENTRAL STATIONS

The "RECO" Folder tells all—Write for it to-day

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225 FIFTH AVENUE.....CHICAGO, ILL.

THE circulation of the ELECTRICAL REVIEW is several thousand copies greater every week than any other electrical weekly and the American Newspaper Directory gives it the "Gold Mark" indicating circulation of the highest quality.

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Manufacturers of

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TRUE TO GAUGE

We make magnet wire absolutely as it should be made—soft-drawn and true to gauge.

It can be depended upon. Also we can be depended upon to follow specifications exactly, and to make deliveries on the dot.

We make also: Weatherproof and trolley wire, flat wire, and all styles of asbestos, cotton and silk-covered wires.

We should be consulted whenever electrical wire of any form is required.

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SIMPLEX

RUBBER INSULATED

WIRES

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Aerial Submarine
Flameproof
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PROMPT ATTENTION TO SPECIAL REQUIREMENTS

THE SIMPLEX ELECTRICAL CO.
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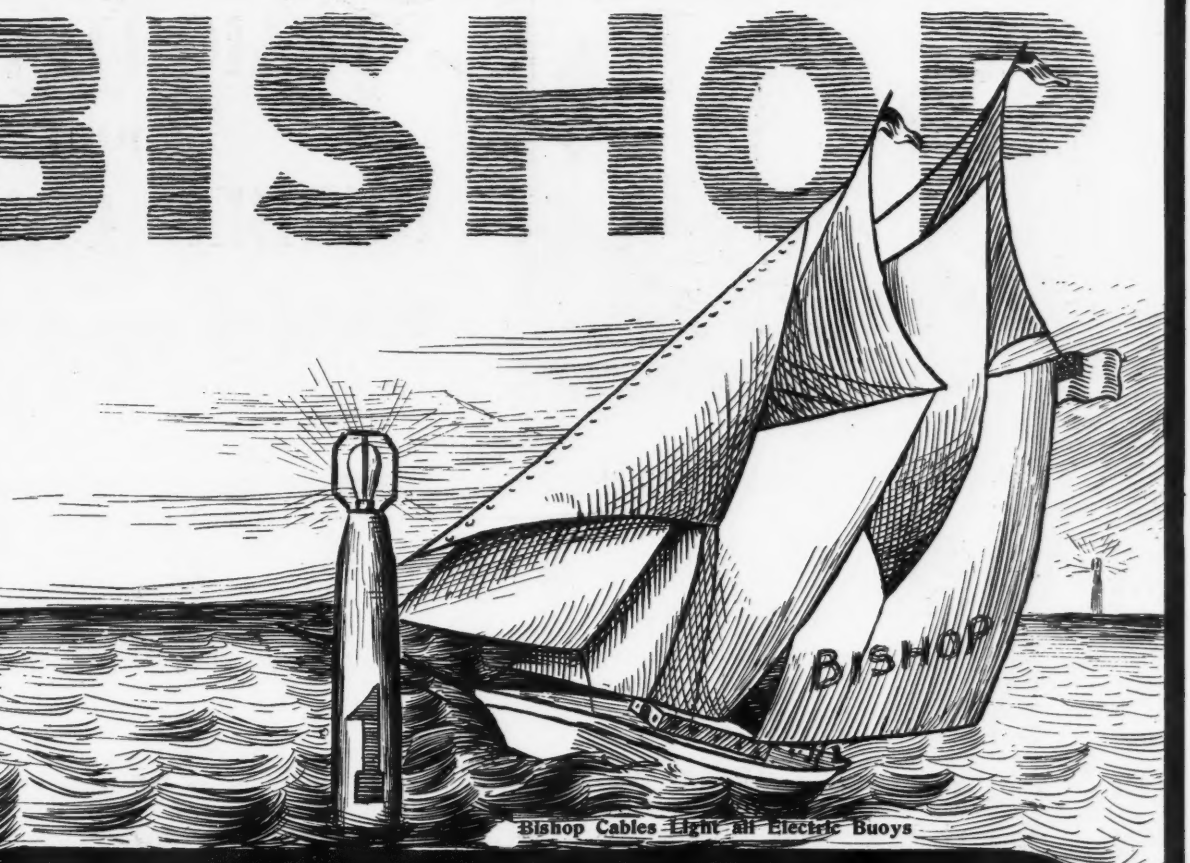
BISHOP



Bishop Cables Light all Electric Buoys

"Old but up-to-date"

The Year of 1905

¶ Finds the BISHOP GUTTA-PERCHA COMPANY in its fifty-eighth year of unparalleled success in the manufacture of HIGH GRADE INSULATED WIRES and CABLES.

¶ The present year finds the BISHOP GUTTA-PERCHA COMPANY equipped with the best and most modern machinery, and using the best compounds of India rubber and gutta-percha, as the conditions require.

¶ We will devote ourselves to HIGHER GRADES and NEW REQUIREMENTS in the line of electrical conductors, and solicit business for CENTRAL STATIONS, CAR WIRING, UNDERGROUND, SUB-AQUEOUS and in all other places where high grades are required.

¶ We also make ELEVATOR CABLES, Traveling or Standing Cables for Electric Elevators and Electric Lights in Elevators, as well as for annunciators. Write us for estimates.

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STRAIGHT FACTS ABOUT RUBBER COVERED WIRES AND CABLES

An Insulated Wire which is to withstand the assaults of envious competition, and at the same time the rigid scrutiny and actual service of the purchaser, must be flaw-proof.

An Insulated Wire to be **really good** must be **wholly good.** It must be good at all points. It must be armed for battle and there must be no flaw in its armor.

PARANITE RUBBER COVERED WIRES AND CABLES

have won the success that they have because they are **really good** wires, which answer all purposes to which insulated wires may be put.

Do you know that the largest wire buyers are our customers.

Do you know that the most exacting engineers to-day are specifying **Paranite Rubber Covered Wires and Cables** for underground, aerial, submarine and inside use?

This means positively that our quality is dependable—that we follow specifications without deviation and without argument—that its firmness, flexibility and insulating qualities remain perfect under most extraordinary strains, and are not impaired by the action of heat, acids, water, etc.—That it will stand all climates and will not deteriorate in storage.

Wherever you find a smart, up-to-date central station manager, alive to all the demands of modern wiring, who believes that a dollar well expended the first time is better than a dollar saved to spend twice as much later for replacing inferior wires—there you will find a good customer of the

Indiana Rubber and Insulated Wire Co.

JONESBORO, INDIANA

The Standard for Rubber Insulation

Extends to You

A Happy and Prosperous New Year

OKONITE

Needs no introduction. Your own experience proves its claims

"The Best Is the Cheapest in the End"

Let This Be Your Motto for

1905

The Okonite Company

253 Broadway, New York

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IS THE

STANDARD FOR RUBBER INSULATION FOR MARINE USE

Largely used for installations on BATTLESHIPS and CRUISERS

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SUBMARINE CABLES

Manufactured by the Okonite Co.

Are in ALL PARTS of the WORLD

They show the HIGHEST INSULATION
They are UNAFFECTED by EXTREMES of TEMPERATURE
THEIR LIFE IS UNEQUALED

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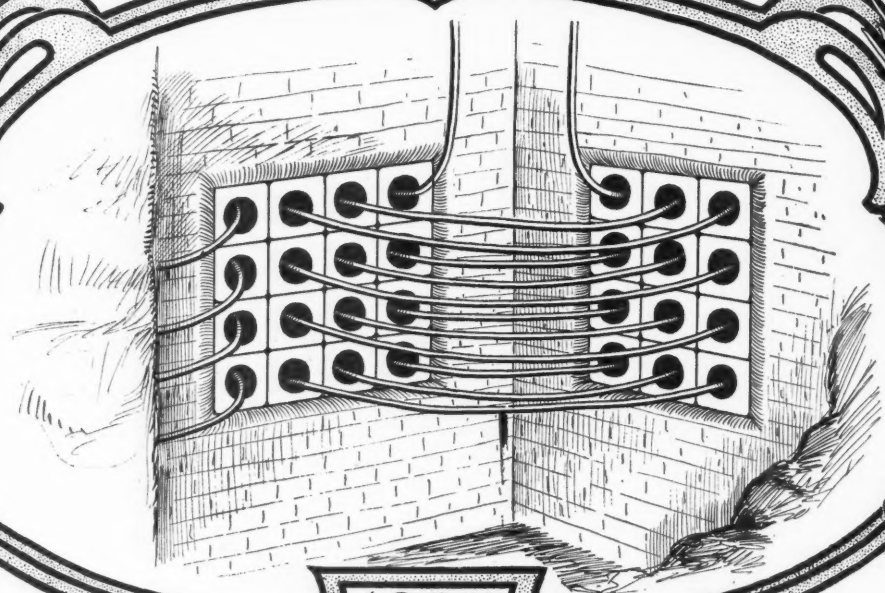
Underground Wires and Cables

No "SHORT CIRCUITS" on High-Tension Currents!
No "GROUNDS" on Telephone Cables!
No "FAILURES" on Signal Wires!



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THE USE OF

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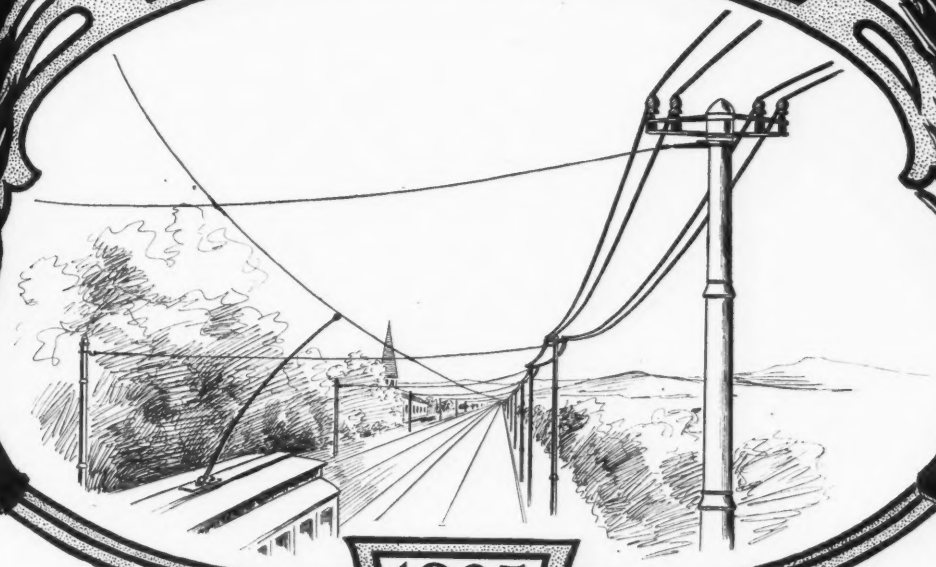
FEEDERS FOR POWER TRANSMISSION

is a **GUARANTEE** of

AN UNINTERRUPTED SERVICE and

THE SAFETY OF ITS PATRONS



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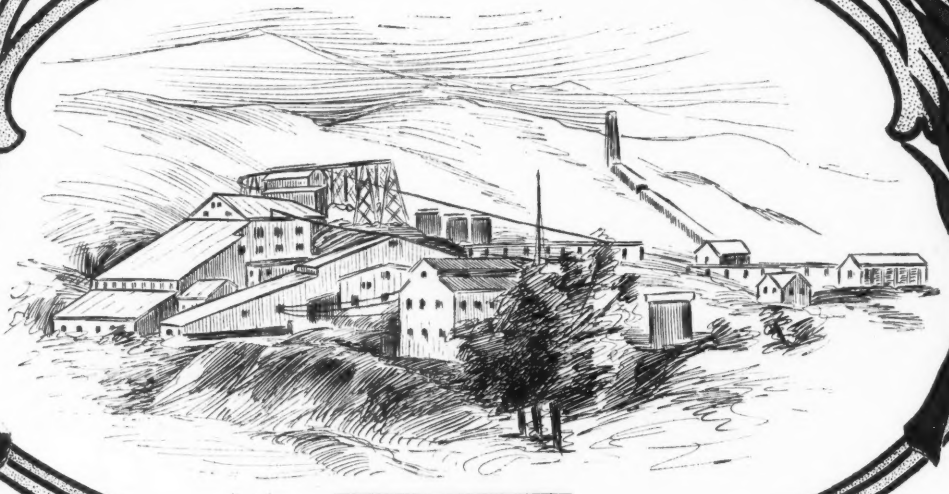
Toughness

With GOOD INSULATION Is a Very Large Factor of

Safety and Economy in Mining Operations

OKONITE FILLS THE BILL



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OKONITE — The Standard for Rubber Tape

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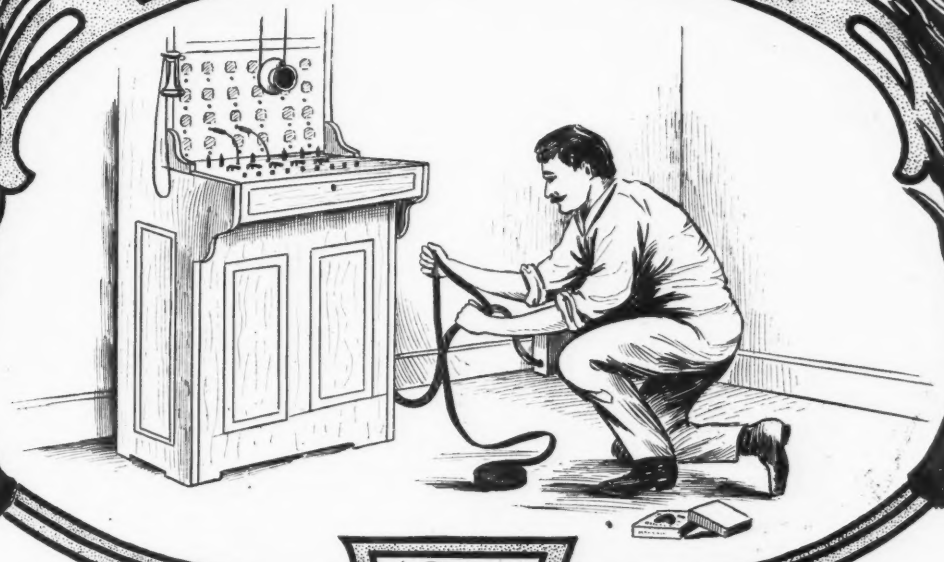
A Guarantee for Perfectly Insulated Joints



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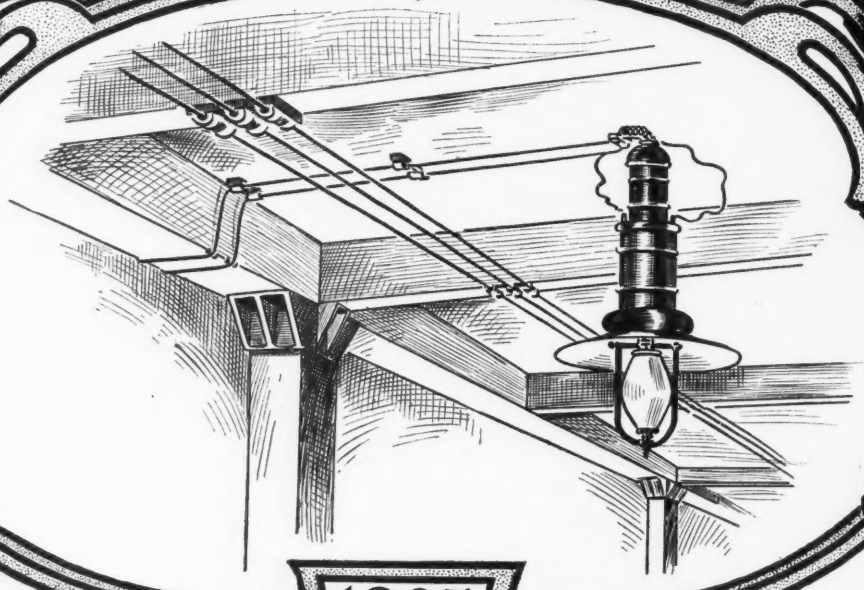
THE BUILDING THE SWITCHBOARD
THE TELEPHONE
Should Not Be Neglected

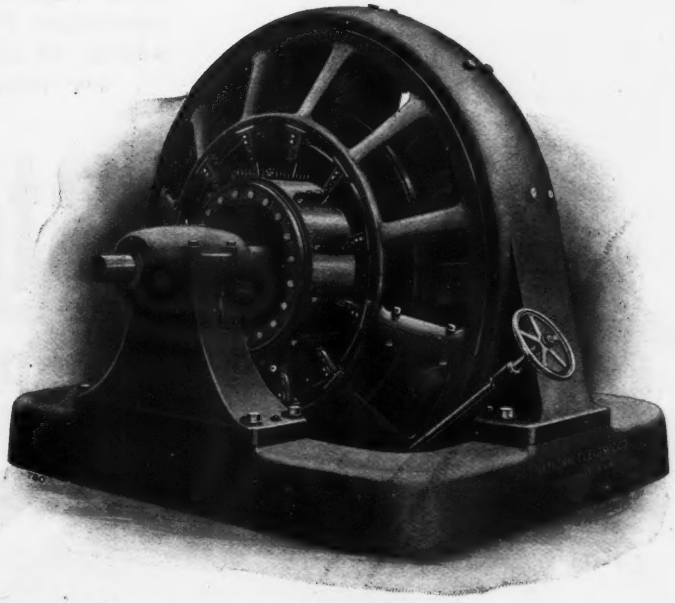
OKONITE

Once Installed Trouble Ends
No Burn-Outs No Replacements



1905

ROTARY CONVERTERS



1000-K. W., 600-VOLT, 250 R. P. M. ROTARY CONVERTER

Two of these machines installed at the West Allis sub-station of the Milwaukee Traction & Light Company

For

Street Railway Service

Modern Design . . . .
Accurate Construction
Superior Performance

National

National Electric Co.

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VARIABLE SPEED DRIVING

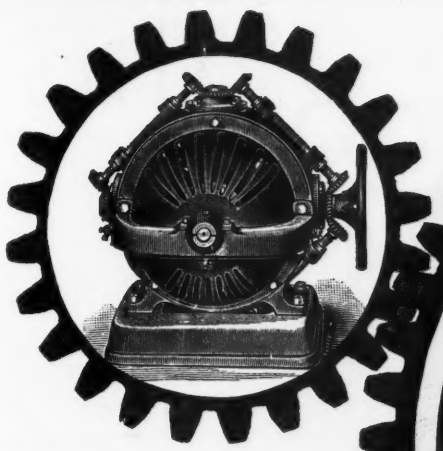
of MACHINE TOOLS
PUMPS

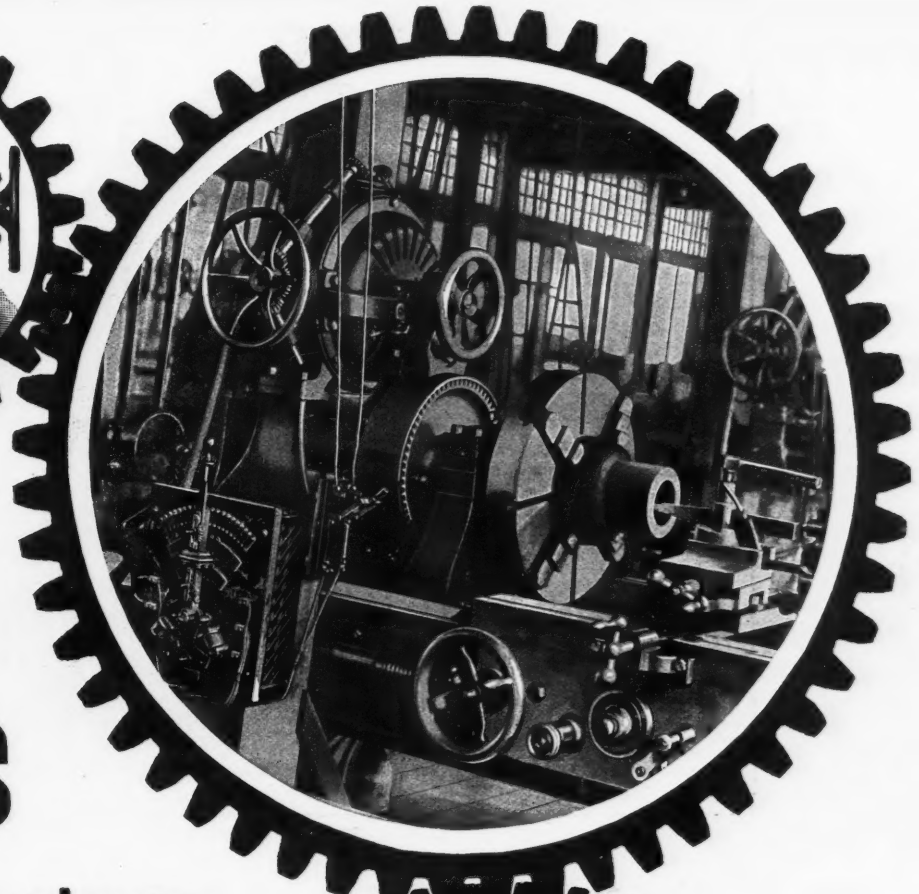
Printing Presses and Other Machinery where high efficiency close regulation and maximum H. P. capacity at all speeds are required

Stow

Present

FOR
BELT
CHAIN
OR GEAR
CONNECTION





Motors

Unequaled Advantages

Simplicity of Construction

Perfect Control of Speed

High and Practically Uniform Efficiency at Any Imaginable Speed between Highest and Lowest

Full Rated Capacity at Lowest Speed or Highest

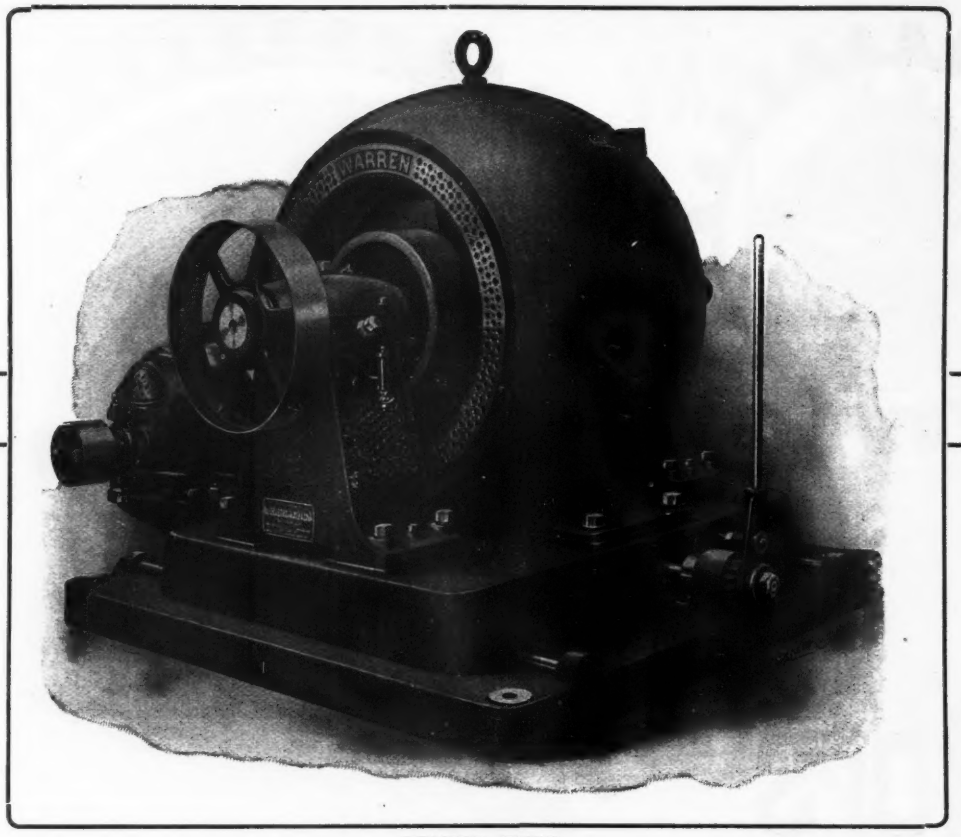
Steadiness of Speed under Changes of Load

Requires no "Controller," Rheostat or Resistance, Except Ordinary Starter

Only One Voltage Required to Produce Wide Range of Speed

WRITE for Our Bulletins
They Describe These Motors in Detail and Illustrate Many Applications

STOW MFG. CO., BINGHAMTON NEW YORK



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The WARREN ALTERNATOR

IS BUILT TO INCREASE DIVIDENDS

Isn't it a fact that a great deal more money is spent in regulating devices than in the actual body of the machine such as reaction coils, compounded coils, automatic regulators, armature circuits, adjustable transformers and other intricate machinery?
Why is all this expensive complicated paraphernalia needed?
Why do you pay for a lot of unnecessaries?
You wouldn't buy a suit of clothes and pay for a lot of ribbons and tassels hanging on them, would you?
Wouldn't you consider a machine that could do without all this and regulate properly, a good business proposition?
Remove these devices from any known alternator and the generator would be useless.

THE WARREN ALTERNATOR

maintains a given voltage without the use of any extraneous device and possesses an inherent regulation far surpassing any other apparatus known.
The *Warren* is made exclusively by us and no other firm.
That's our Trade-Mark. That's your assurance of satisfaction

WARREN ELECTRIC MF'G. CO.

SANDUSKY, - - OHIO, U. S. A.

RUMSEY ELECTRICAL M'F'R'S CO.
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A. M. SEARLES
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WESCO SUPPLY CO.
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DUNCAN-HOBSON ELECTRIC CO.
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GOLD MEDAL

SINGLE-PHASE ALTERNATING-CURRENT MOTORS

GOLD MEDAL

STATIC TRANSFORMERS

SILVER MEDAL

SWITCHBOARD INSTRUMENTS

The apparatus built by this Company received unusual recognition by the International Jury of the Louisiana Purchase Exposition, as above list of awards indicates. These awards were made after a comprehensive series of tests which enabled the performance of the apparatus to be gauged as well as its appearance and mechanical construction. By confining our attention to a limited line of products, we are able to maintain a high degree of perfection, this fact being amply evidenced by the constantly widening sphere of our influence. We seek—

TO SUPPLY FIRST-CLASS APPARATUS
TO HAVE ITS PERFORMANCE ENTIRELY SATISFACTORY TO THE CUSTOMER
AND TO EMPLOY METHODS OF DOING BUSINESS WHICH WILL MERIT THE CONFIDENCE OF OUR FRIENDS

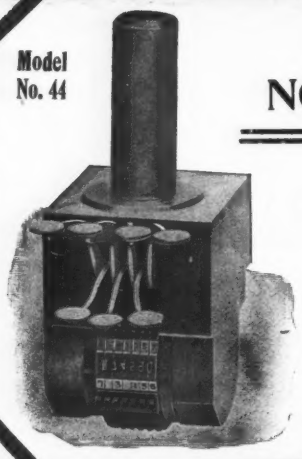
Have you received our latest publication?

"ANSWERS TO SOME CENTRAL STATION QUESTIONS ABOUT SINGLE-PHASE MOTORS."

A paper read before the October meeting of the Kansas Electric Light Association by G. PERCY COLE

Bulletin No. 68—Single-Phase Motors
Bulletin No. 69—Motor-Generator Sets
Bulletin No. 65—Static Transformers
Bulletin No. 64—Power Transmission Transformers
Bulletin No. 67—Instruments

WAGNER ELECTRIC MANUFACTURING COMPANY
ST. LOUIS, U. S. A.



/20423/ NOT LIKE THIS **BUT** —41516— LIKE THIS

There is all the difference in the world between hand and machine numbering

OUR MACHINES Number Accurately, Space Uniformly and Sink the Figures Precisely the Same Depth.

AN HOUR—for a day's work under ordinary conditions.

Brass, Iron, Steel, Tin and Fibre Plates, Tags and Parts of any size or shape.
Any Number Instantly Set in Stamping Position.
Operated in any Punch, Screw or Lever Press. Send for catalogue and state your requirements.

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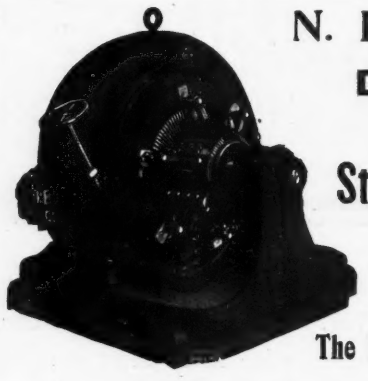
346 BROADWAY, NEW YORK, U. S. A. Branch, 2 Cooper Street, Manchester

THE ELWELL-PARKER ELECTRIC COMPANY OF AMERICA

CLEVELAND ..... MANUFACTURERS OF ..... OHIO, U. S. A.

STANDARD AUTOMOBILE BATTERY CHARGING MACHINES

We have been manufacturing for ten years and have thousands of machines out that are giving complete satisfaction



N. E. MOTORS

DYNAMOS AND Storage Batteries

WRITE FOR CATALOGUE AND PRICES

The New England Motor Co.
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SEND FOR . . .
"THE STANDARD MOTOR BOOK"
It describes our different styles
THE ROBBINS & MYERS CO.
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ALTERNATING CURRENT MOTORS AND CEILING FANS
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CENTURY ELECTRIC CO.
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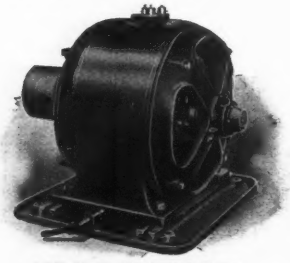
DO YOU KNOW
that
Eck Dynamos and Motors Are Good Machines?

TRADE MARK.

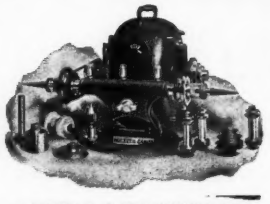
They have an efficiency and reliability that make them a most profitable investment.

BULLETIN NO. 35

Eck Dynamo and Motor Works
BELLEVILLE, N. J.



¼-20 H. P. Protected Type.



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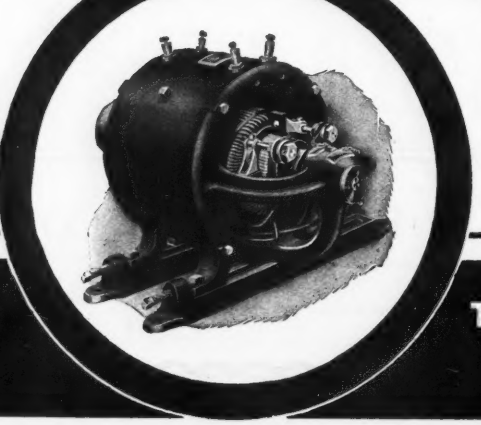
Central Station Men Will Be Interested

In our new Six-Speed Buffing and Grinding Motor for Alternating Current : : :

Made also for Direct Current. 1-6 H.-P. 300 to 3000 R.P.M. By encouraging the use of these motors you can increase your day load.

THE HOLTZER CABOT ELECTRIC CO.
NEW YORK BOSTON (Brookline), MASS. CHICAGO



THOUSANDS OF ENGINEERS
all over the United States will stand behind the

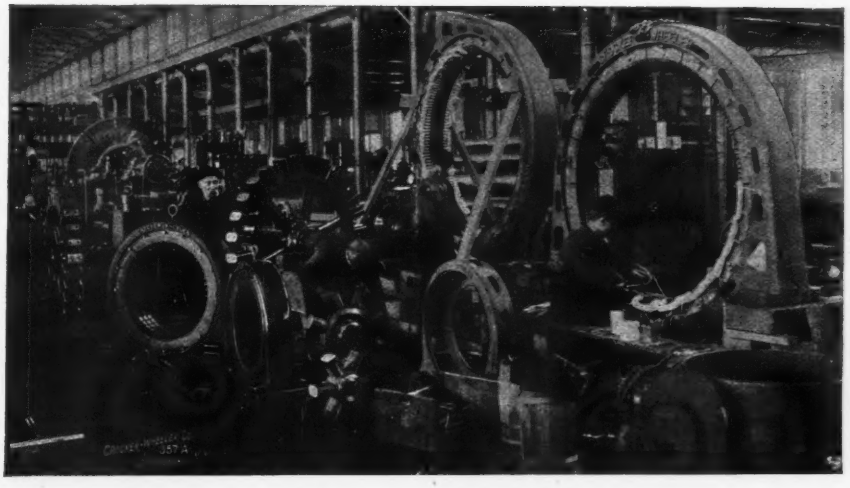
HOBART MOTOR

and back up the assertion that it is the most satisfactory motor now on the market.
ONE REASON—they are economical and efficient in operation.
ANOTHER—they need so few repairs, and practically no attention.

The reason for this rare combination is given in Bulletin No. 603

THE HOBART ELECTRIC MFG. Co.
MAY STREET ..... TROY, OHIO.

Crocker-Wheeler Alternators



View in Our Shops, Showing the Smaller Alternating-Current Machines in Process of Construction

Our alliance with Brown, Boveri & Cie., the greatest experts in alternating current in the world, who are our consulting engineers, has enabled us to take our place in the front rank of alternating-current manufacturers in this country.

Having had sixteen years' experience in the field of direct-current manufacture we are able to build alternating-current machinery thoroughly adapted to the American market.

Three 4,000 K. W. Crocker-Wheeler alternators, now building, will supply power to all the street railways in San Francisco and vicinity.

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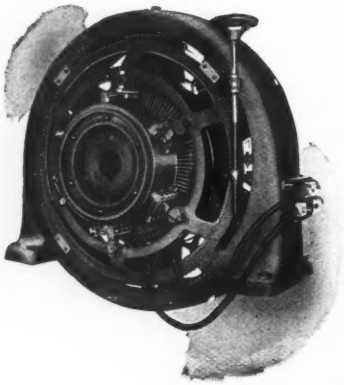

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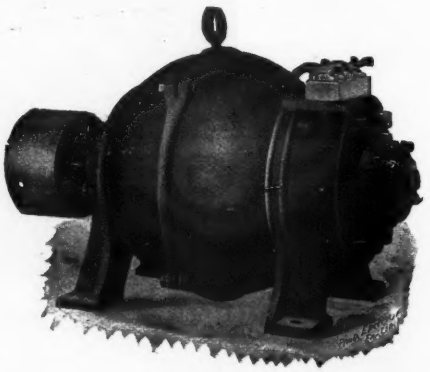

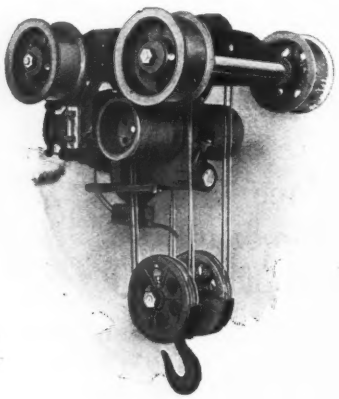

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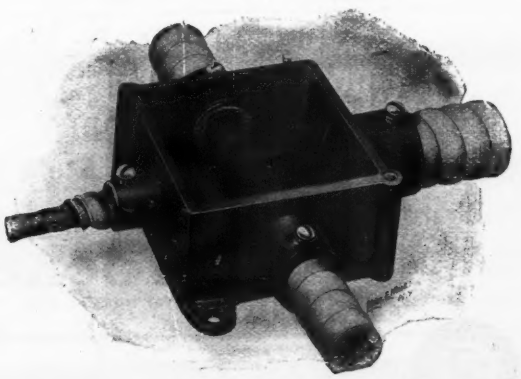

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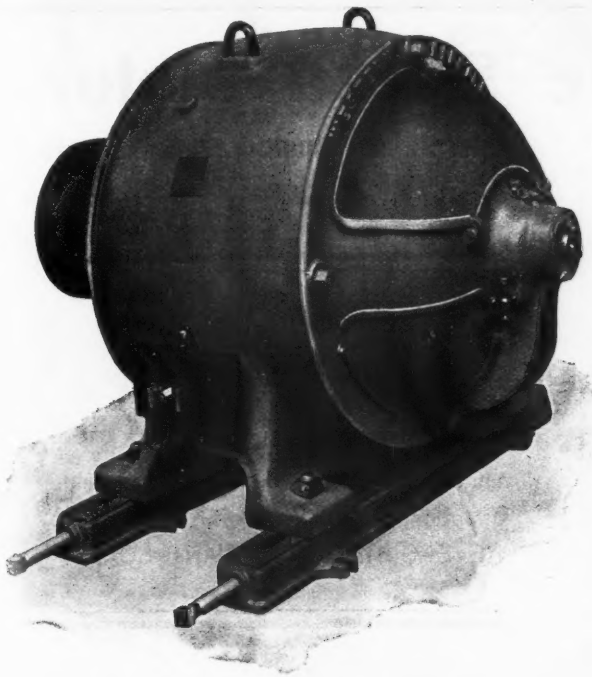

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AND

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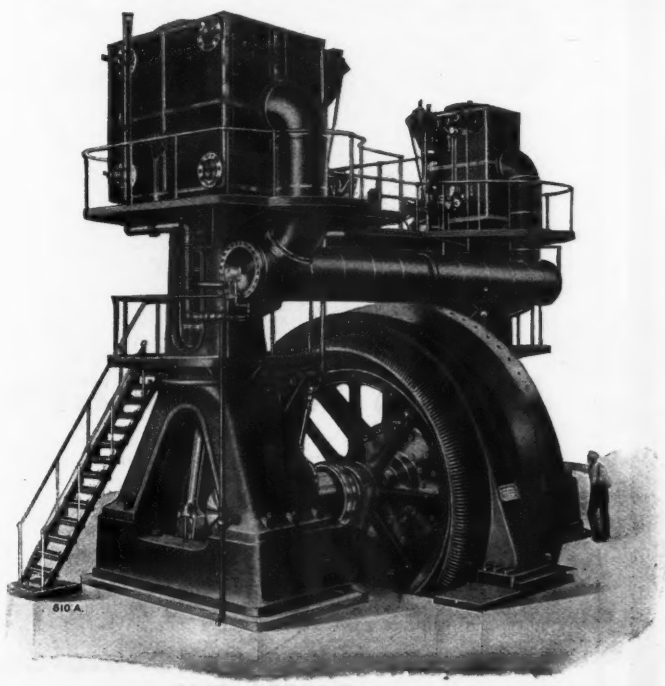

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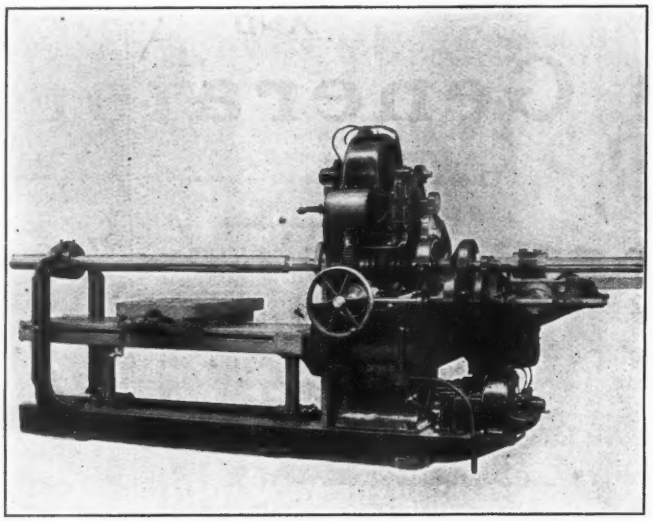

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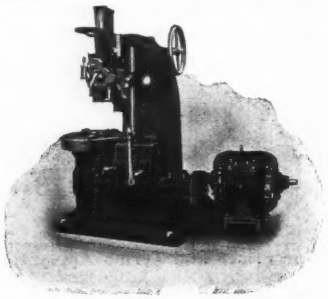

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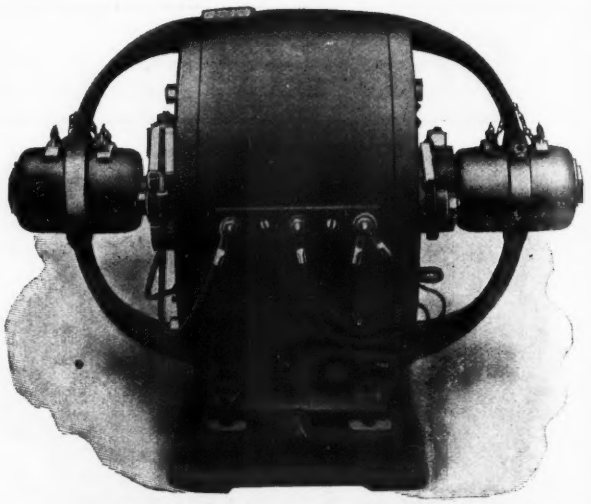

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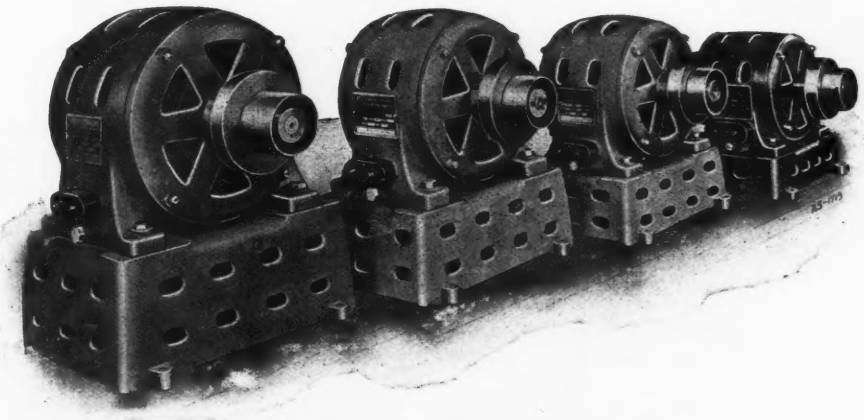

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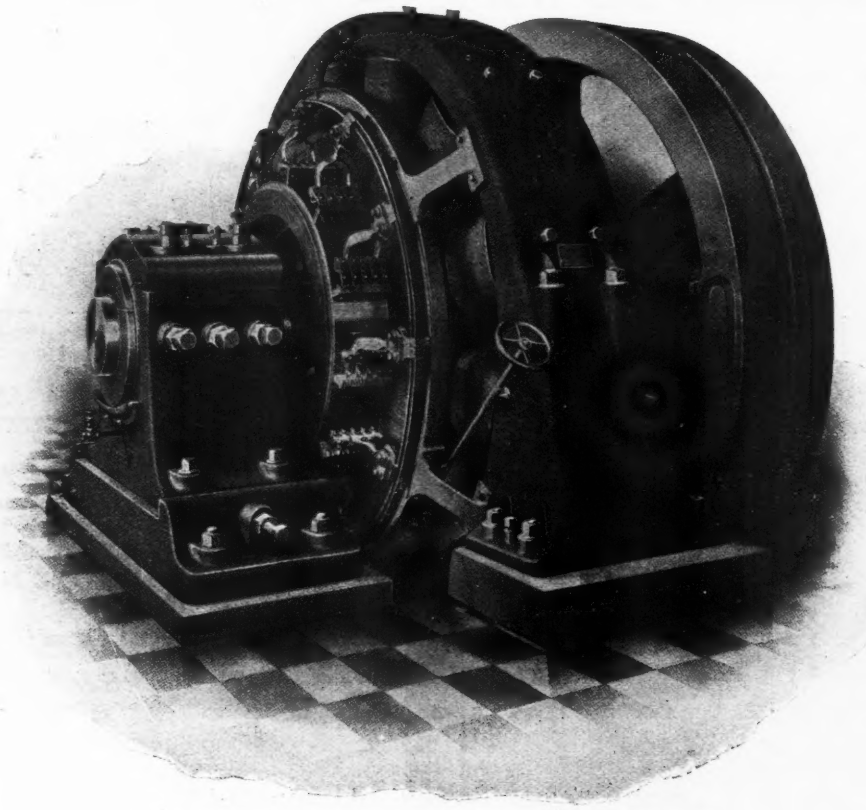

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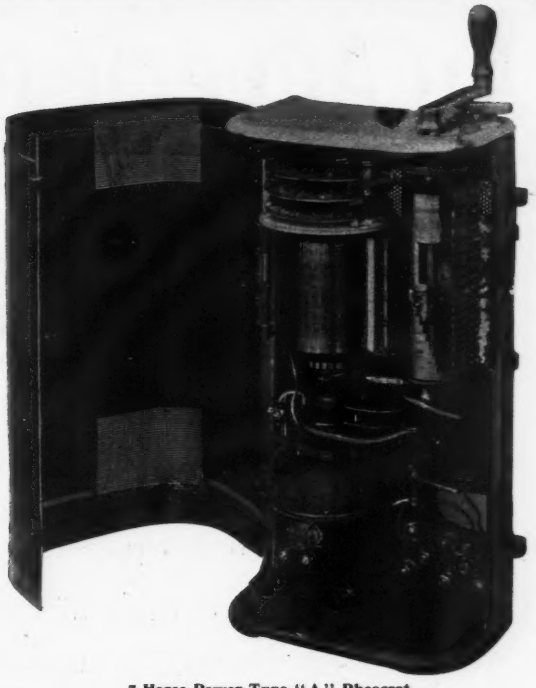

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27 Inches High, 14 Inches Wide, 8½ Inches Deep

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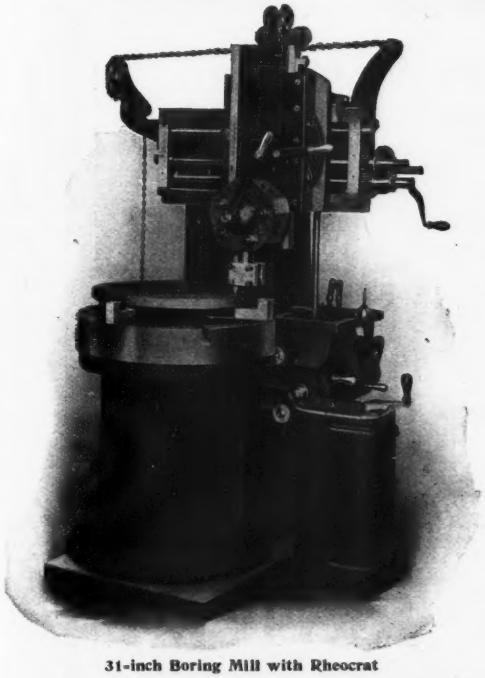

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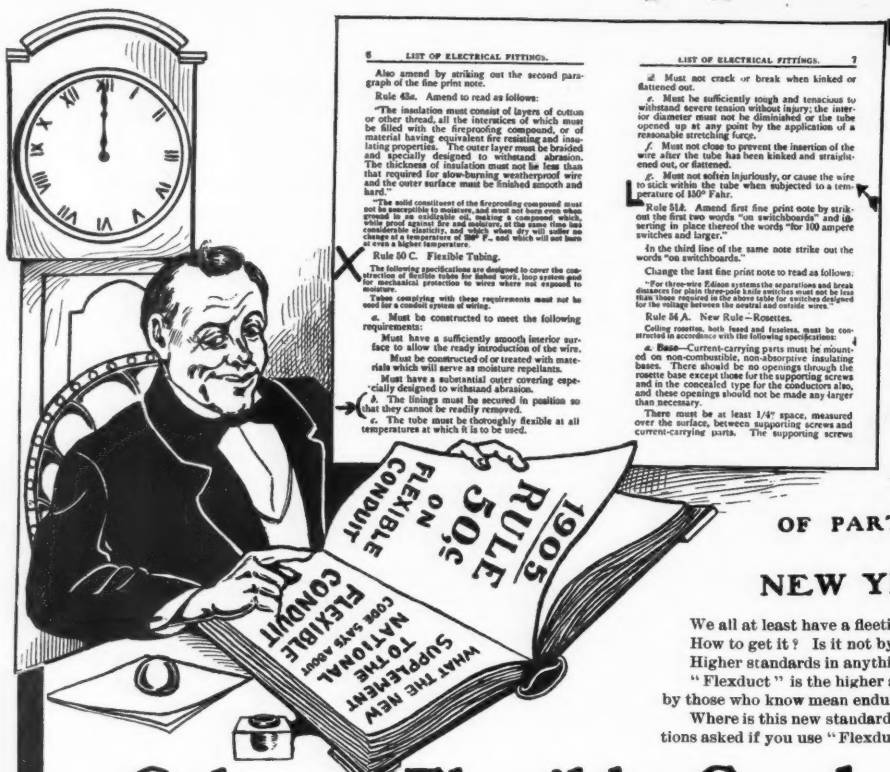

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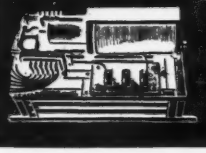

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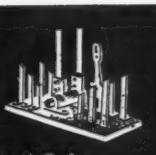

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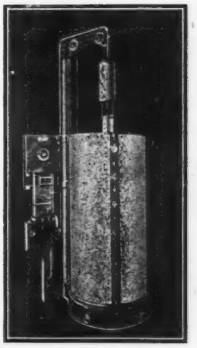

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Shreveport, La.
Aurora, Mo.
Minneapolis, Minn.
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Adrian, Mich.
Salem, Mass.
Plymouth, Mass.
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Allegheny, Pa.
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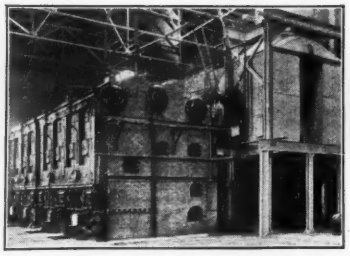

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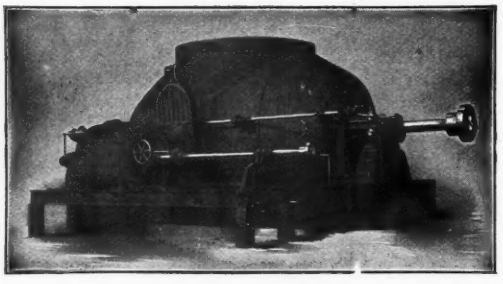

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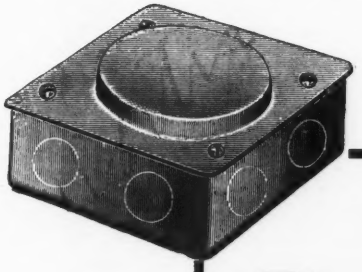

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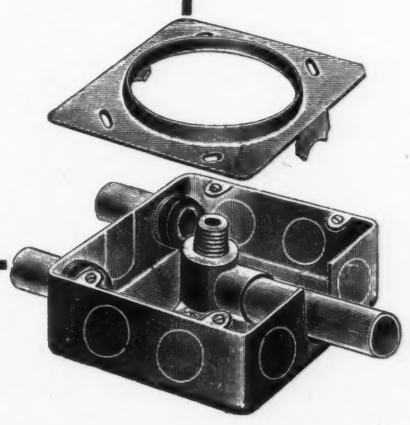

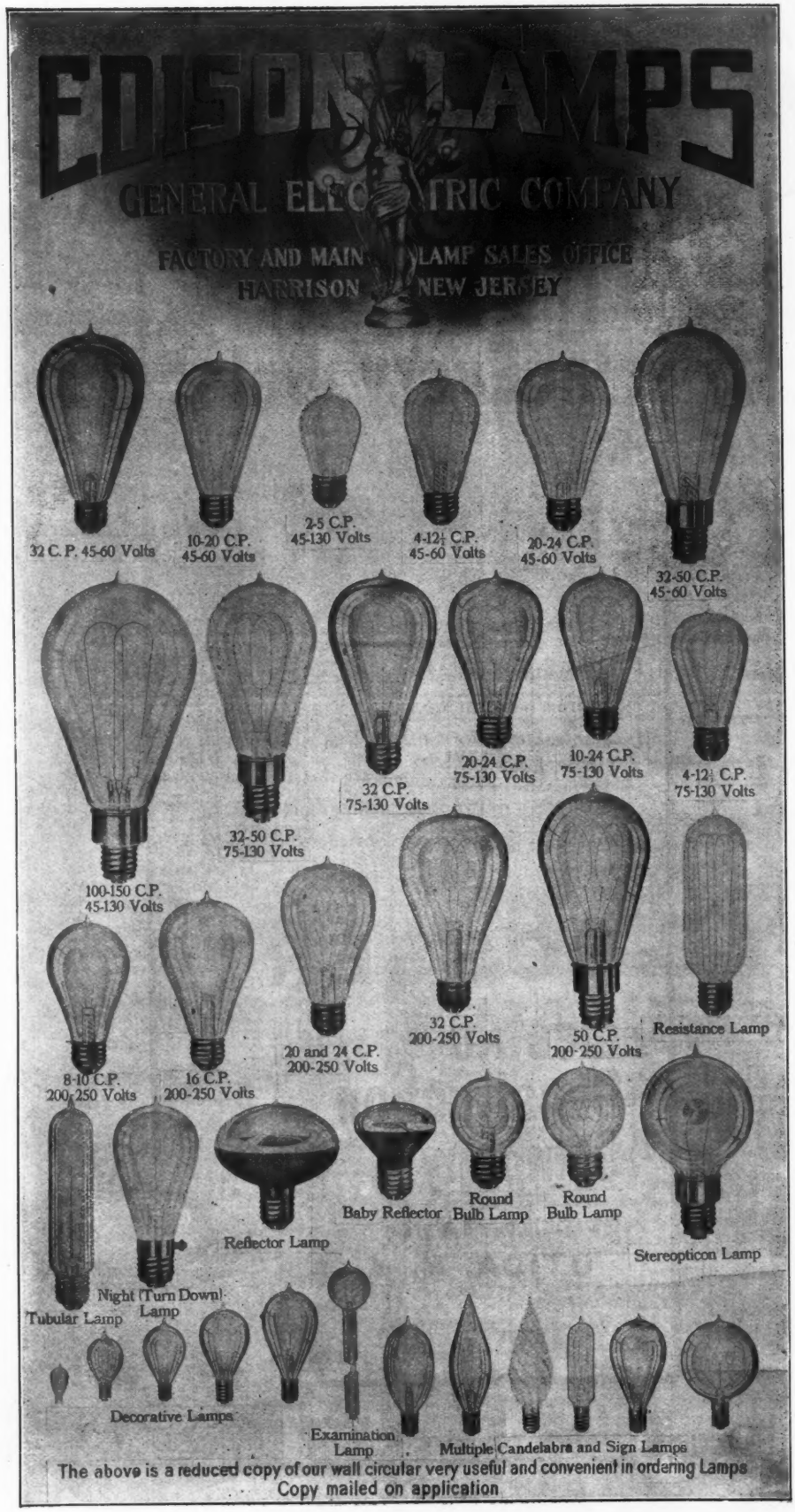
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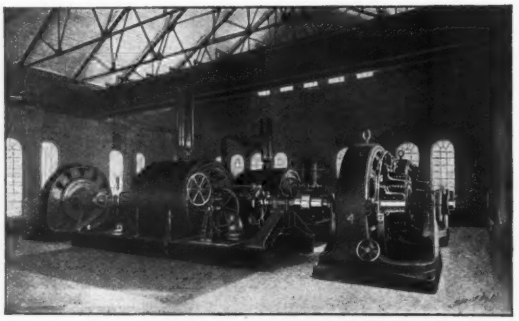

The illustration shows the interior of the power house of the Royal Aluminum Co. at Shawinigan Falls, Quebec, in which are two pairs of 59-inch cylinder gate New American Turbines, with Westinghouse Generators coupled on each end of shaft. One of these wheels was tested in the Holyoke Testing Flume and gave an efficiency of 85.32 per cent. Each pair of these wheels is developing 3,200 H. P. under a head of 125 feet. The Royal Aluminum Company have recently placed an order with us for a third unit, to be in every respect similar to the other two.

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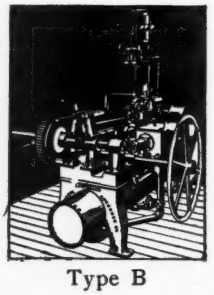

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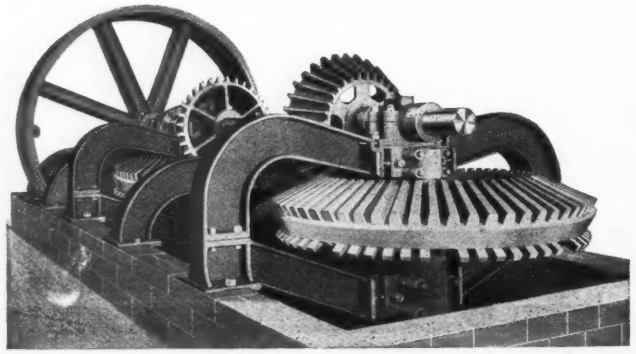

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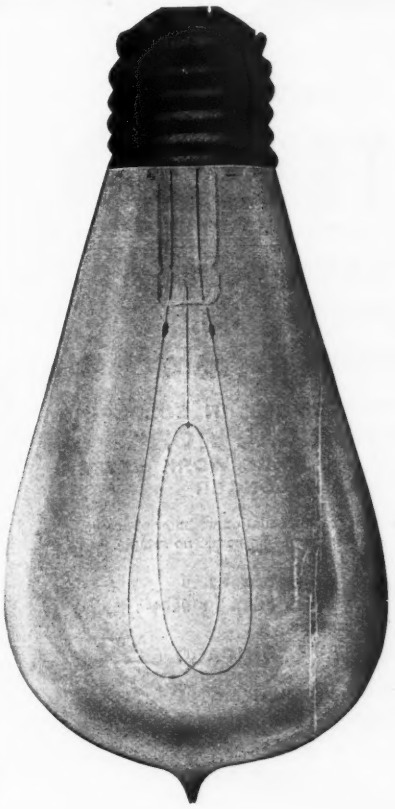

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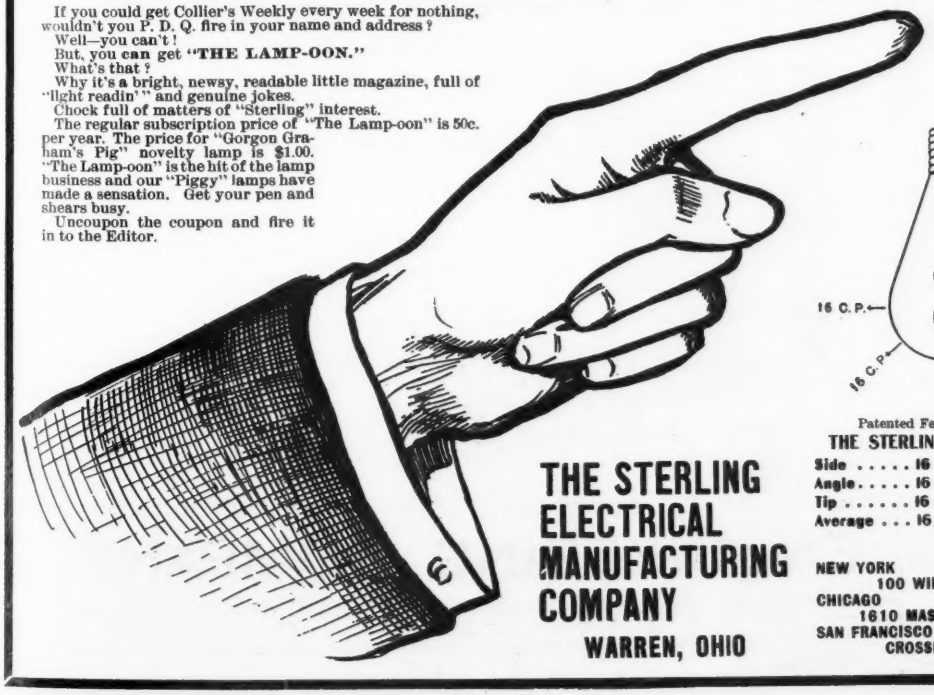

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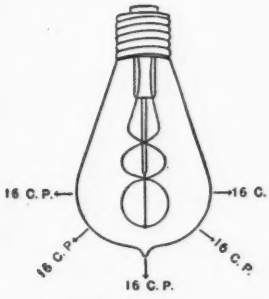

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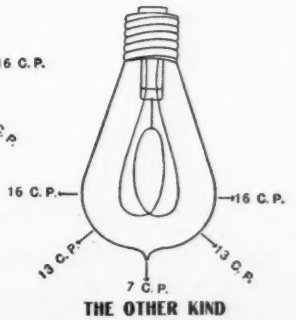

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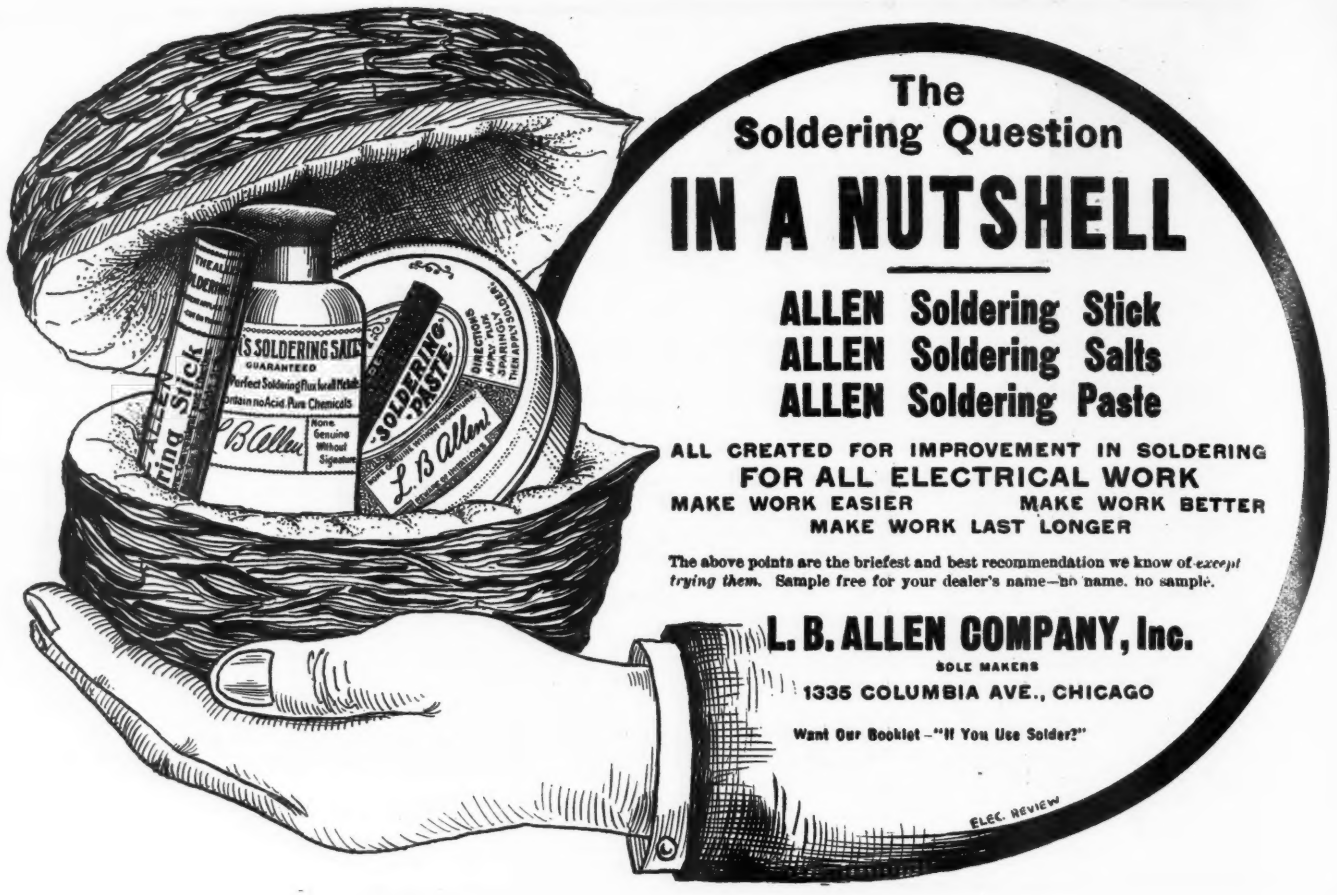

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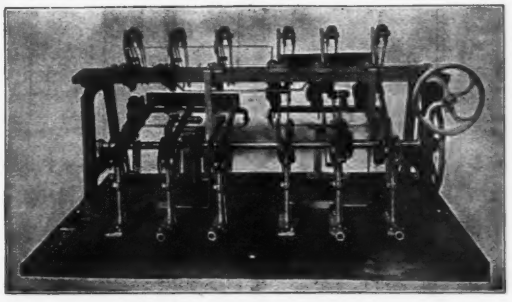

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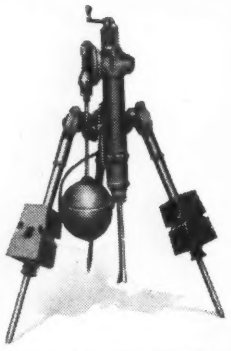

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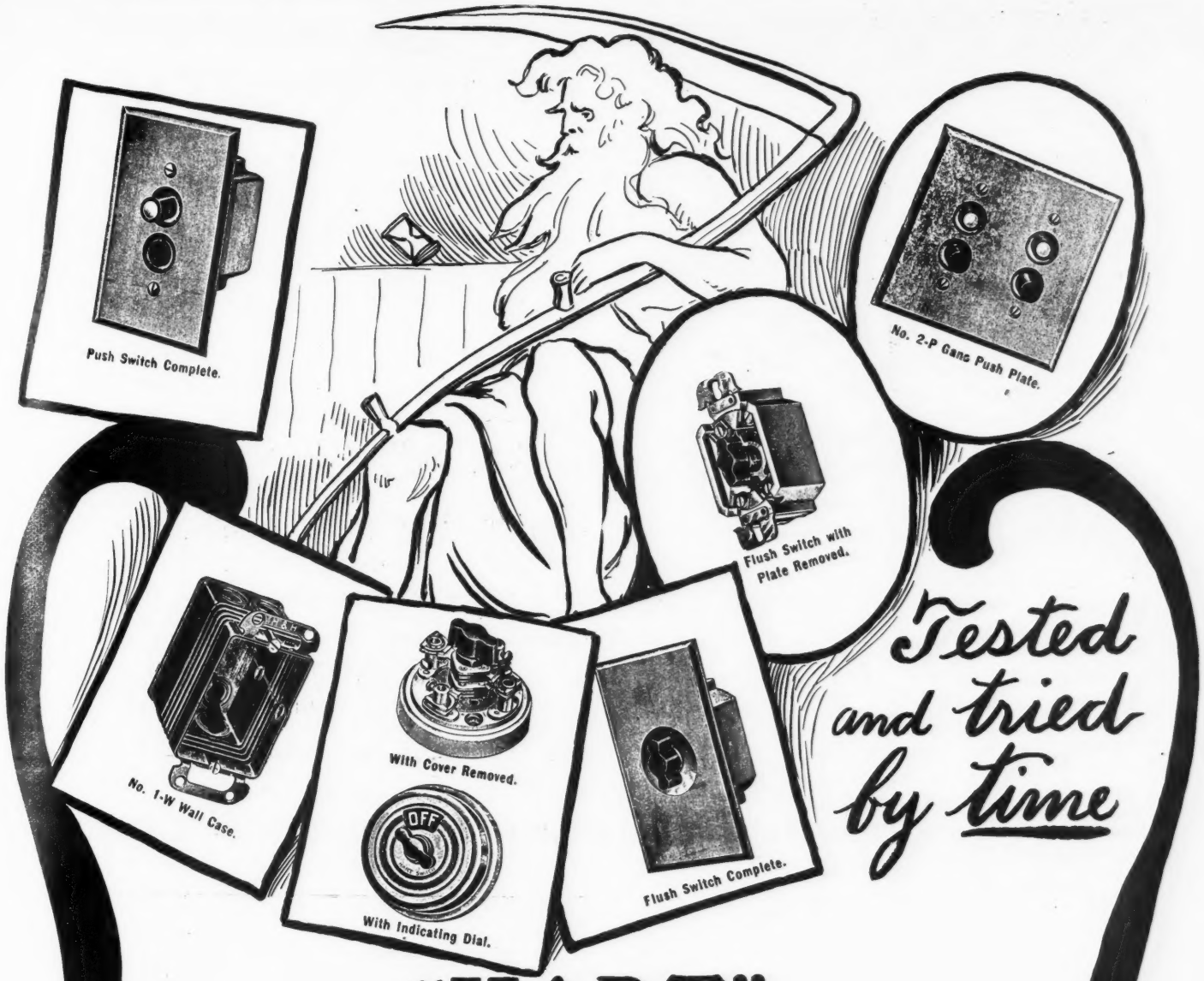

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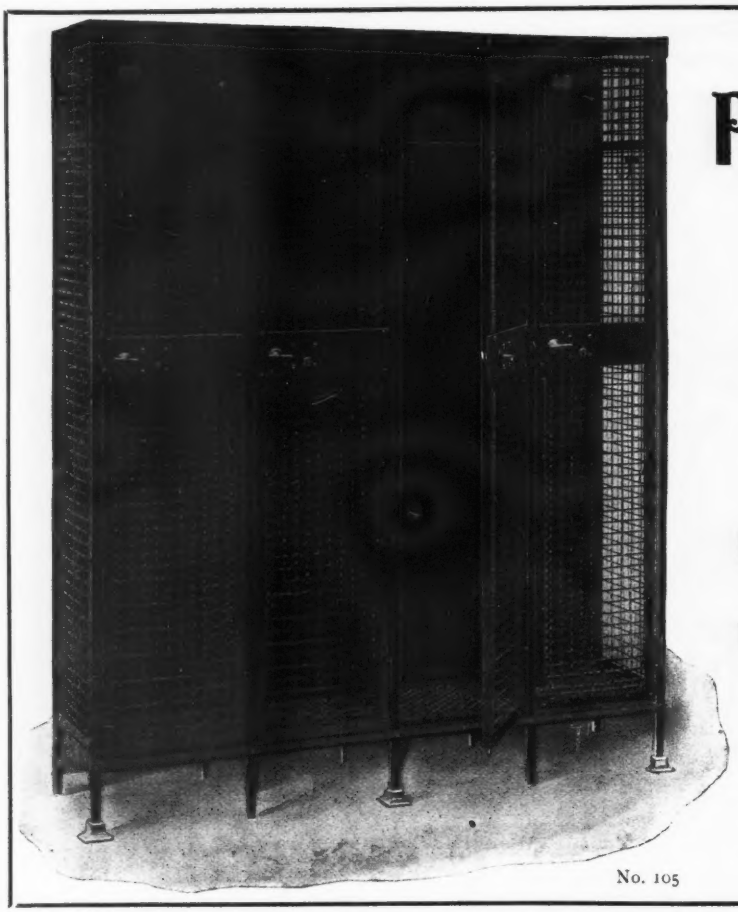

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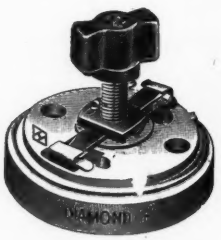

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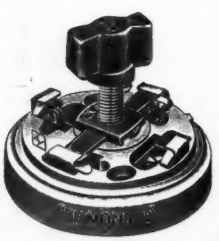

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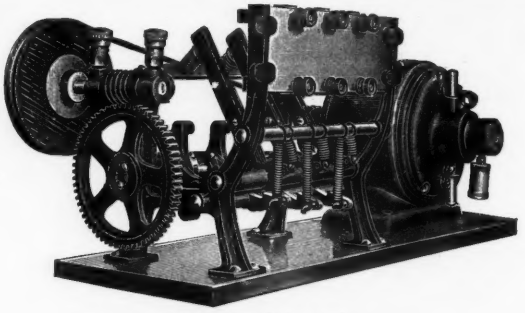

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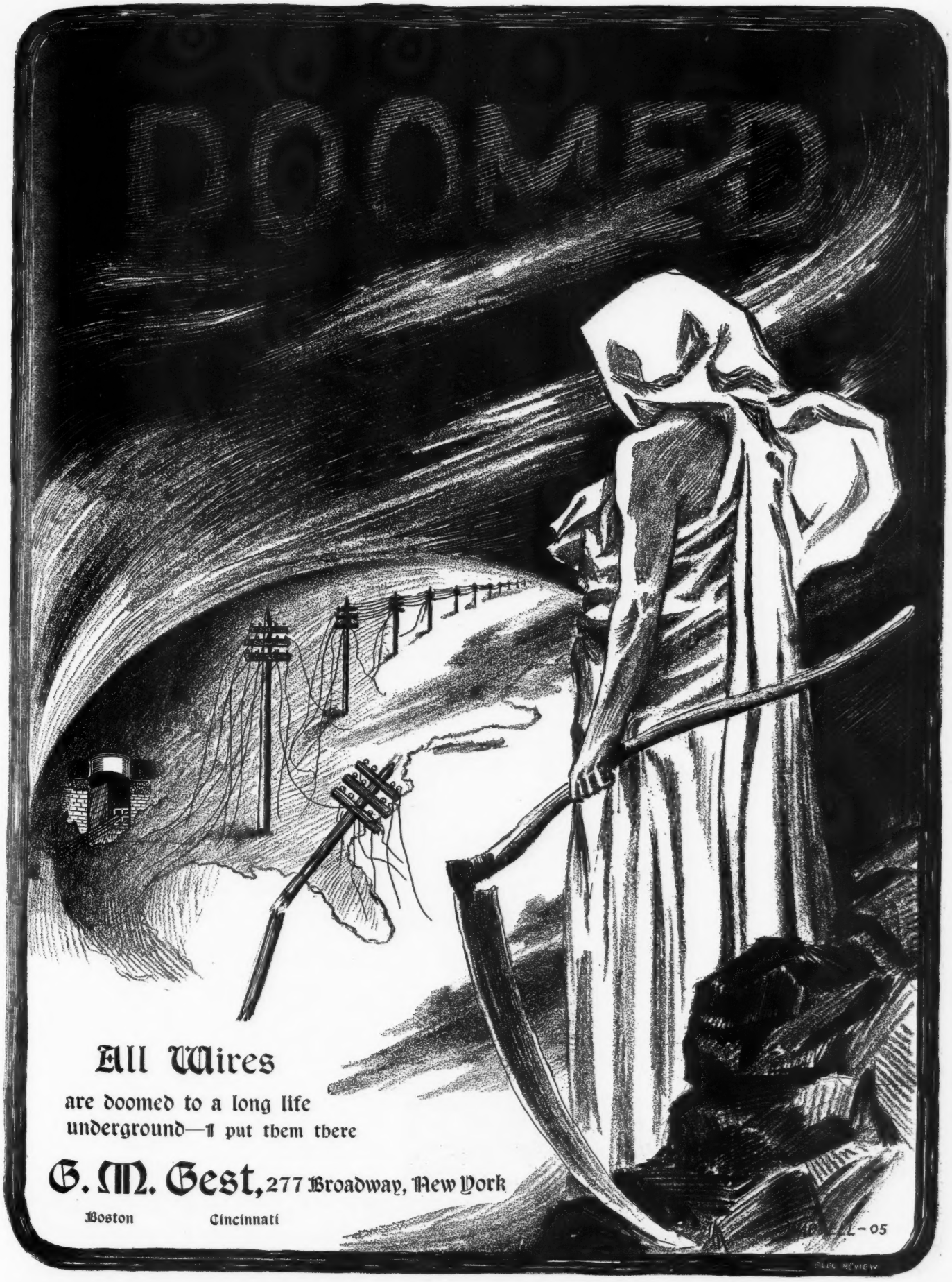
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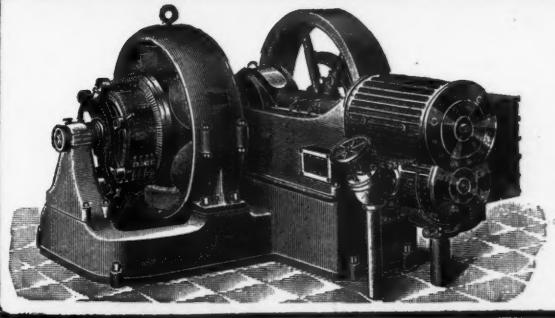

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779,086 Railway-rail stay; Edward Lass, Elgin, Ill., and Hiram H. Sponenburg, Wadsworth, Ill.

779,090 Thermoelectric element; Albert L. Marsh, Lake Bluff, Ill., assignor to William A. Spinks & Company, Chicago, Ill.—A thermometallic element formed of an alloy electronegative to an alloy of copper and nickel and having a melting-point in excess of the melting-point of pure copper, or an alloy of copper and nickel formed with a metal of the chromium group to have a melting-point exceeding that of pure copper.

779,098 Electric plug; Nelson H. Raymond, Brooklyn, N. Y., assignor to Stanley & Patterson, New York, N. Y.

779,104 Railway-rail stay; Hiram H. Sponenburg, Wadsworth, Ill., assignor of one-half to Edward Lass, Ottumwa, Iowa.

779,150 Third-rail system; Giosue D'Esposite, Pittsburg, Pa., assignor of one-half to Stuart Patterson, Pittsburg, Pa.

779,182 Combined circuit-breaker and starting rheostat; Robert H. Read, Schenectady, N. Y., assignor to General Electric Company, New York.

779,190 Static-influence electrical machine; Elihu Thomson, Swampscott, Mass., assignor to General Electric Company, New York—An electrostatic-influence machine having no space for containing ozonized air around its active parts.

779,199 Motor-controller; Charles E. Barry, Schenectady, N. Y., assignor to General Electric Company, New York.

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779,206 Control system; Frank E. Case, Schenectady, N. Y., assignor to General Electric Company, New York—System of master control.

779,207 Sparking igniter for internal-combustion engines; Henry Devlin, Philadelphia, Pa.

779,210 Process of producing barium oxide from barium carbonate; George Egly, Charlottenburg, Germany, assignor to the firm Gebrüder Siemens & Company, Charlottenburg, Germany.

779,213 Car-fender; George A. Füllipp and Charles Huska, East McKeesport, Pa.

779,214 Wire-stretcher; Oscar D. Funk, Rogers, Neb.

779,223 Keyboard-telegraphic transmitter; Maximilien Kotyra, Paris, France.

779,231 Induction-coil; John G. Meyers, East Providence, R. I., assignor to Varley Duplex Magnet Company, Phillipsdale, R. I.—An induction-coil embodying a primary winding divided into sections connected in series, and an electrical controlling device connected in the primary circuit between said sections.

779,245 Wire-reel; Charles W. Stark, Mountain Lake, Minn.

779,247 Apparatus for testing electrical resistances; John B. West and Frederick M. DuBois, Syracuse, N. Y., said DuBois assignor to said West—Combination of two induction coils having their primary windings electrically connected in series, one of the primary windings being adjustable to vary the current strength in its secondary winding, means to indicate the degree of such adjustment, testing terminals and a current-strength indicator.

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779,265 Brush-holder for dynamo-electric machines; Frederick M. Conlee, Madison, Wis., assignor to Northern Electrical Manufacturing Company, Wisconsin.

779,267 Current-controlling system; Arthur C. Eastwood, Cleveland, Ohio.

779,278 Rail-joint; Erick L. Hall, Roachdale, Ind., assignor of one-half to Joseph A. Akers, Roachdale, Ind.

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whether you are the engineer, spending hours each day in the direct path of the big flywheel with its possibilities of sudden death to you and of desolation to those who are dependent upon you; or a workman at some distant part of the plant where a false move might cost you a hand, an arm or maybe your life. It stands between you and the possibility of such death or injury every minute of every working day. It does more than accident or life insurance because it **prevents** losses that neither accident nor life insurance can replace. It insures you against loss of wages caused by the shut-downs which inevitably follow serious engine accidents, and by the half-time headway that often results from cancellation of orders which cannot wait until the plant is restored. It protects you equally from the serious results of your own carelessness in becoming entangled with machinery, and from that bravery which would lead you to risk your own life to save the lives of others and your employer's property. Many men already owe life and limbs to the prompt stopping of the engine by means of the Monarch System, the operation of which is described in the opposite panel. You and your employer should be mutually interested in the Monarch Engine-Stop and Speed Limit System because its benefits are mutual; and you may both have reason to be thankful some day if you use whatever influence you may have to secure its installation.

Our 48-page booklet, "As Others See Us," tells in the words of unbiased users what the Monarch System has done for them. Write for a copy

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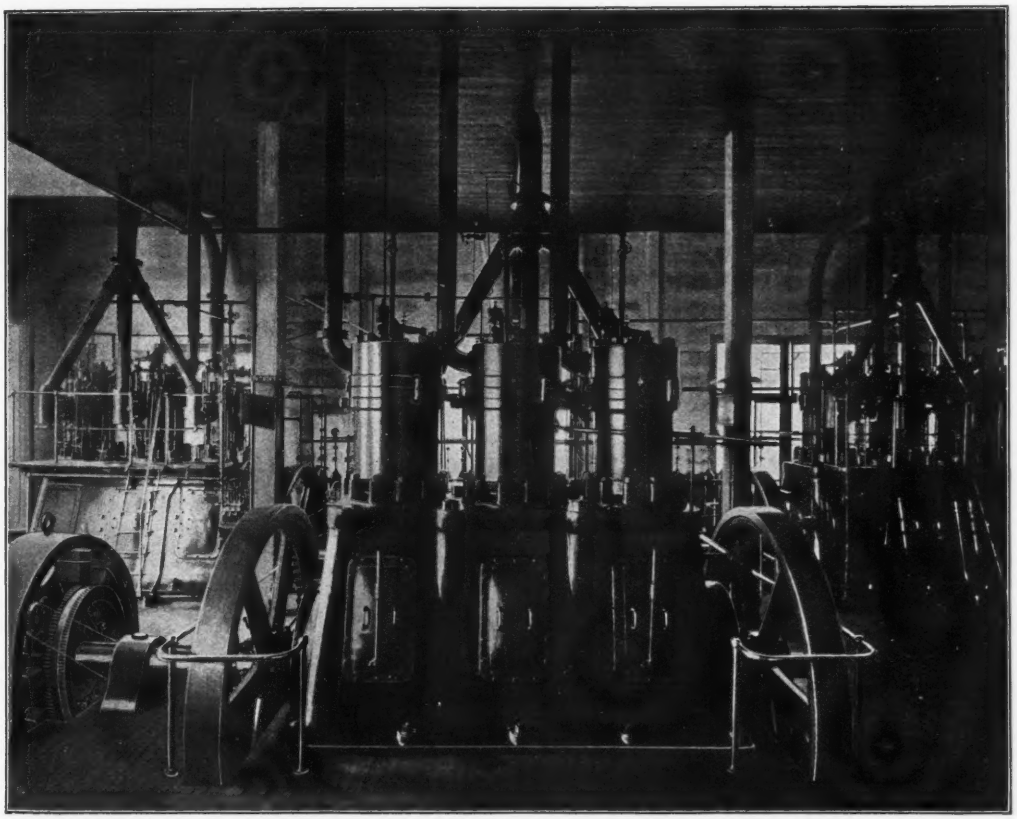


American Diesel Engines Installed at World's Fair, St. Louis, German-Tyrolean Alps Engine Room.

THE plant illustrated was installed for the German-Tyrolean Alps, at the World's Fair, St. Louis, and represents 3—225 B. H. P. Diesel Engines, each direct-connected to 1—165 kw. Bullock direct-current generator.

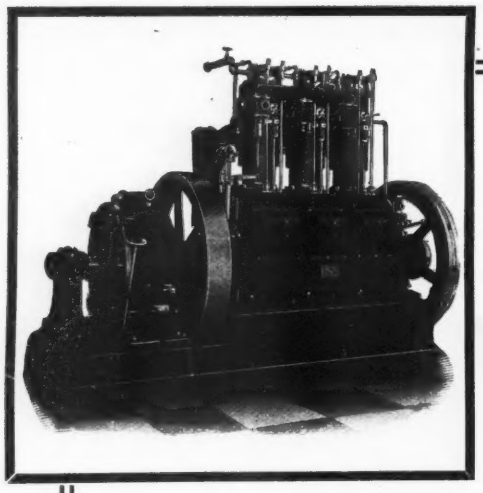
The load was variable, from 75 to 500 kw., with average of 250 kw. per hour or 2650 kw. per day.

The plant was in operation from May 1st to December 1st, and delivered 588,500 kw. hours, with 60,120 gallons of oil, that cost, delivered in storage tanks at the plant, $1,803.60, or an average cost for fuel of $\frac{3}{10}$ of a cent per kw. hour on the switchboard, including all generator and line losses.

There was no reserve power in the plant, every pound of energy that the engines were capable of was required at some portion of the day's run. The service was continuous, and there was no interruption after the first week the plant was put in service.

No repairs whatever were made during the seven months, except such as could be made by the regular attendants.

The average cost of fuel per hour for the season's run was 63c., and it is fair to say that had the Alps installed a steam plant, the charges for labor and repairs in the fire room alone would have equaled this cost, so that the saving in operation, as compared with steam, would equal the total value of the coal the steam plant would have consumed.



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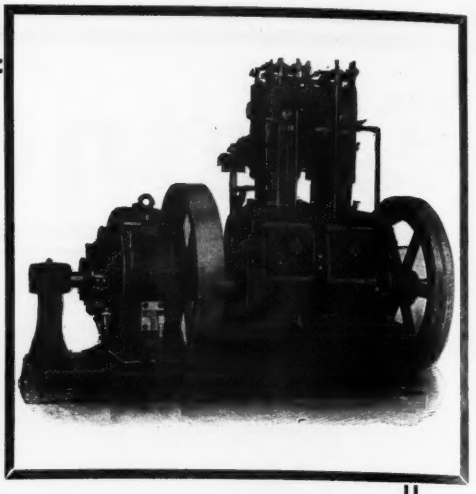

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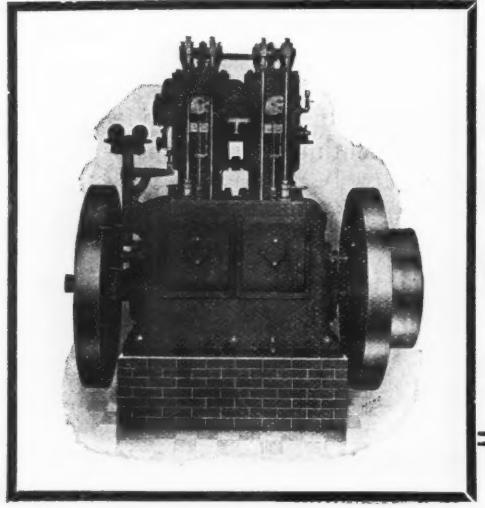

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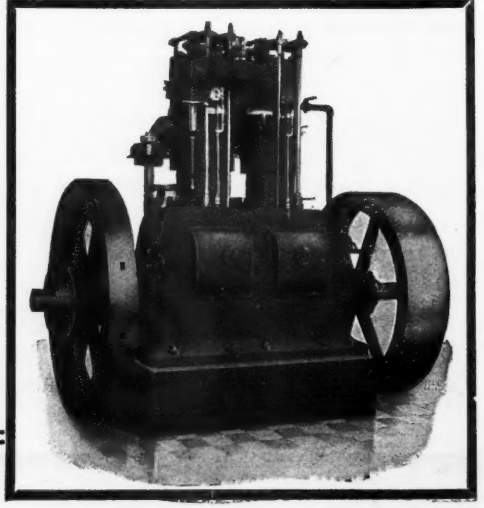

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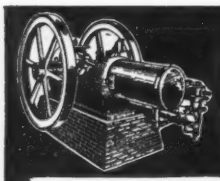

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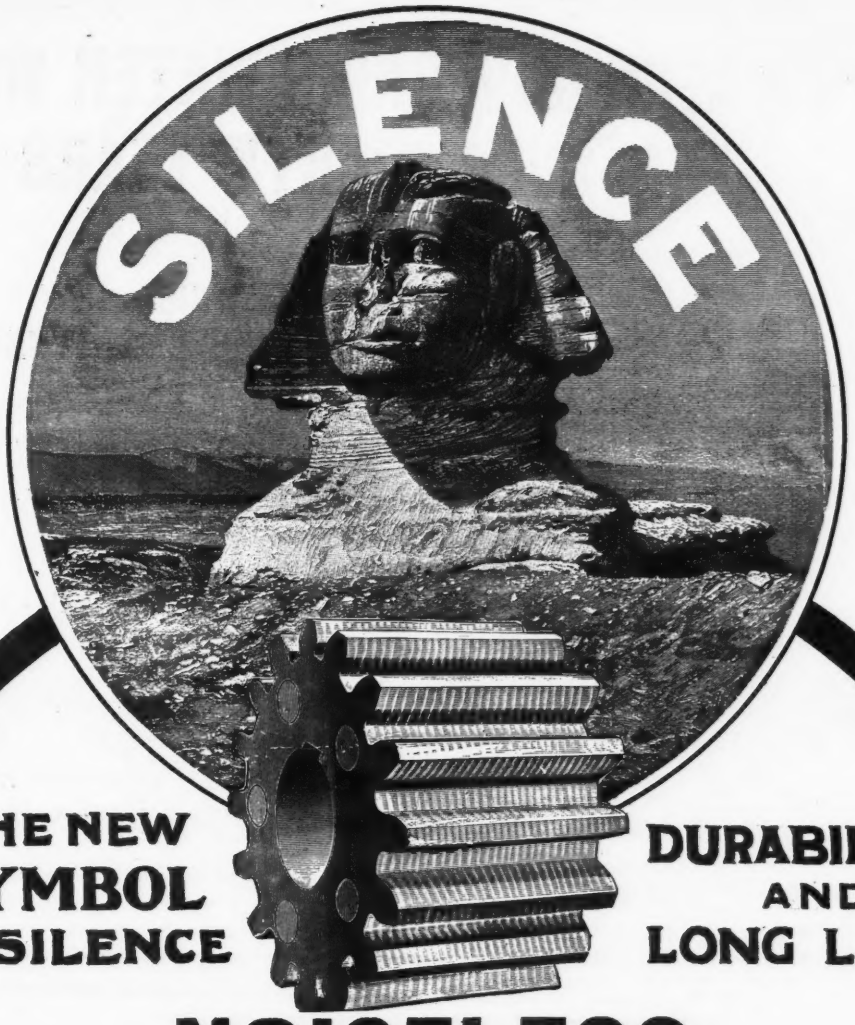

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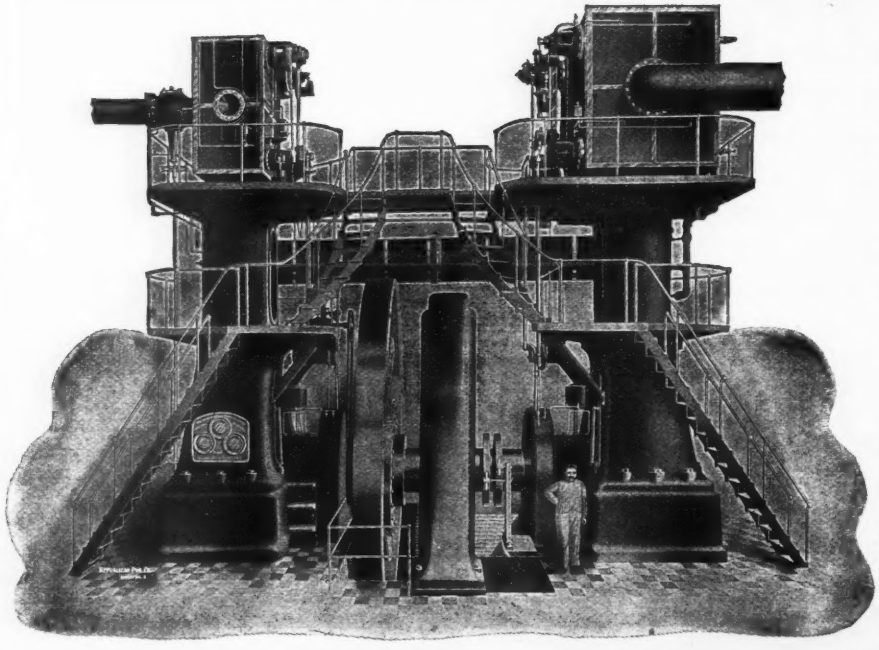

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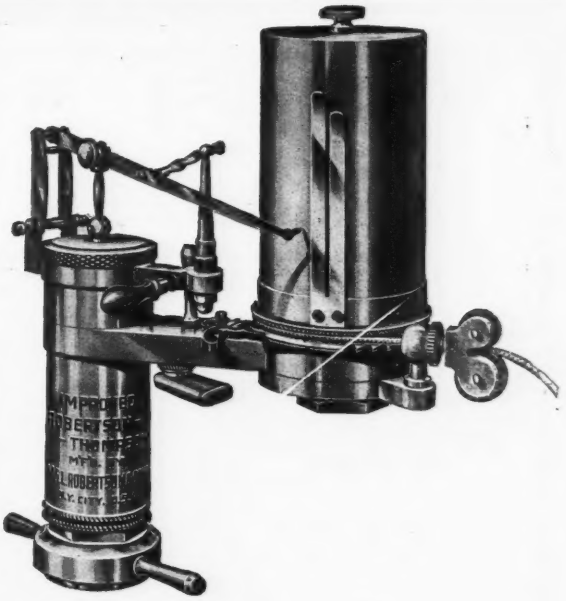

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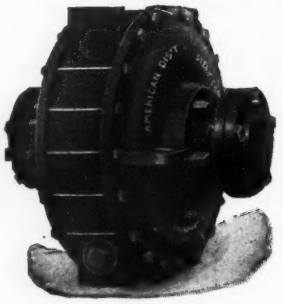

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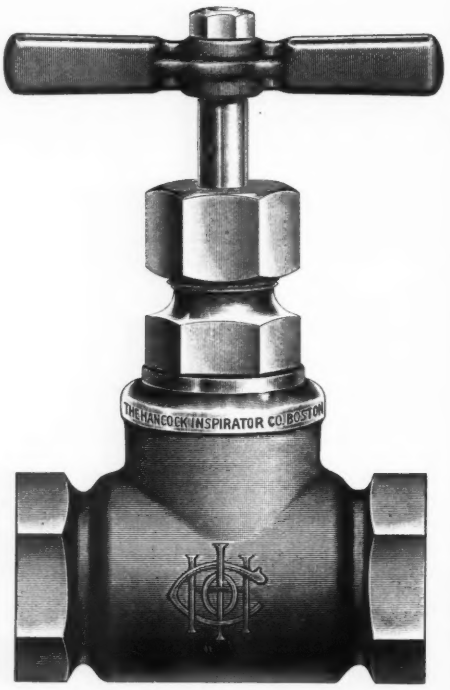

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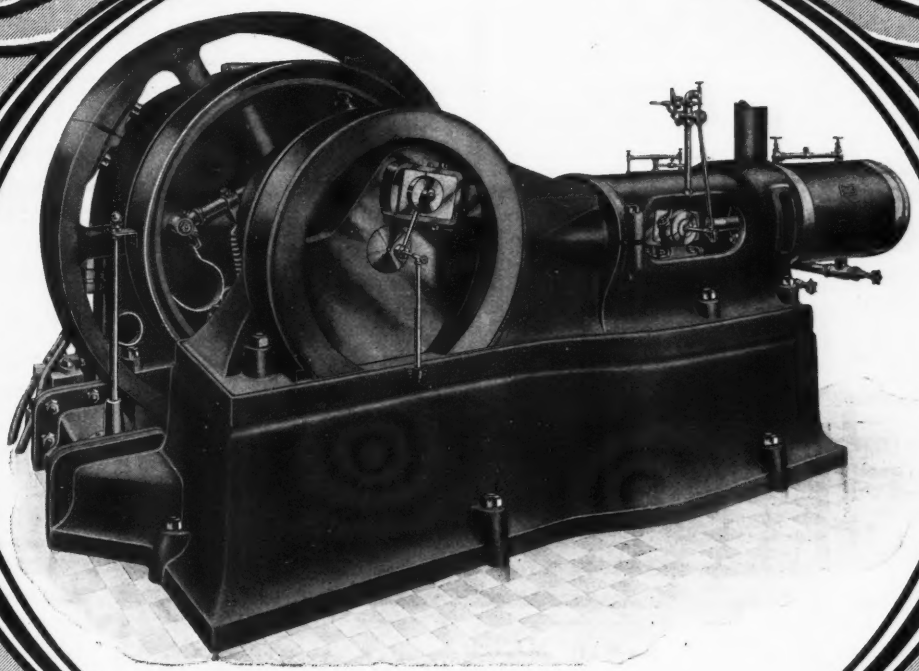

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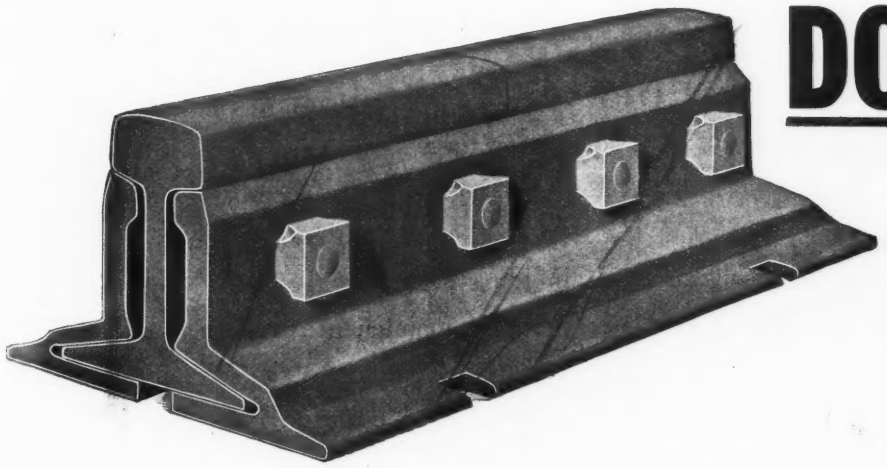

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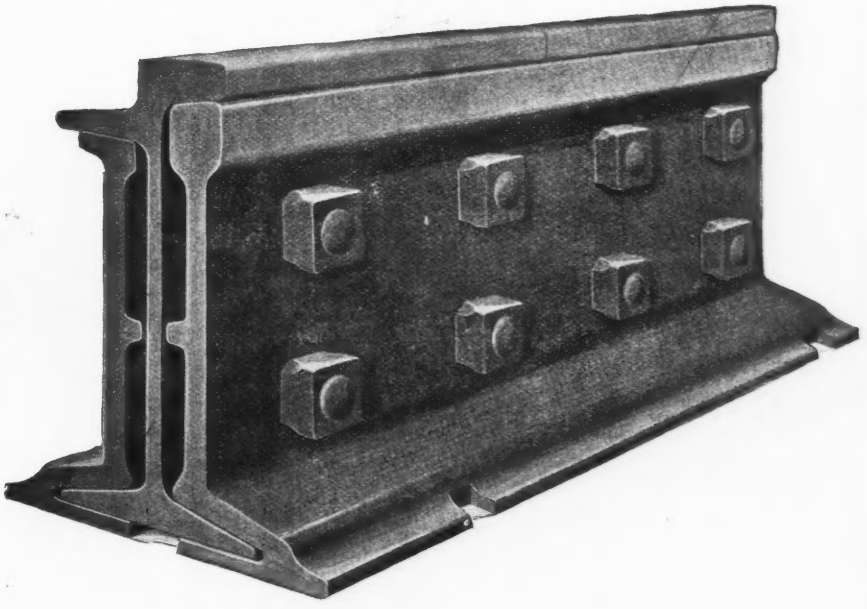

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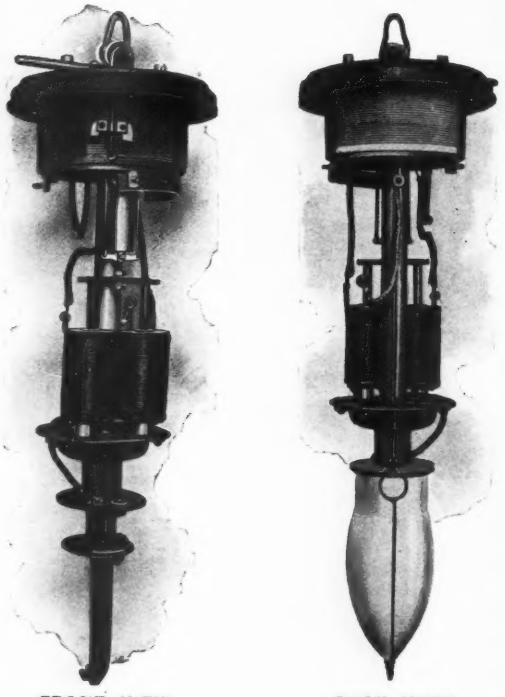

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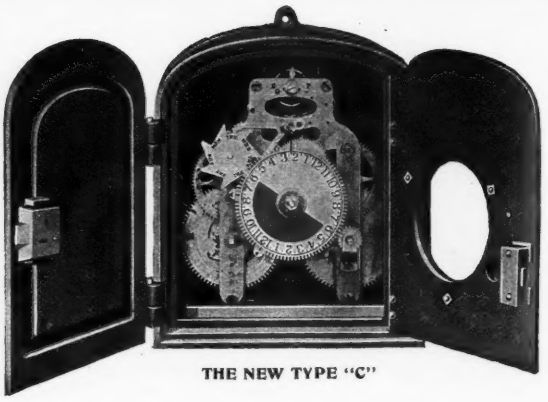

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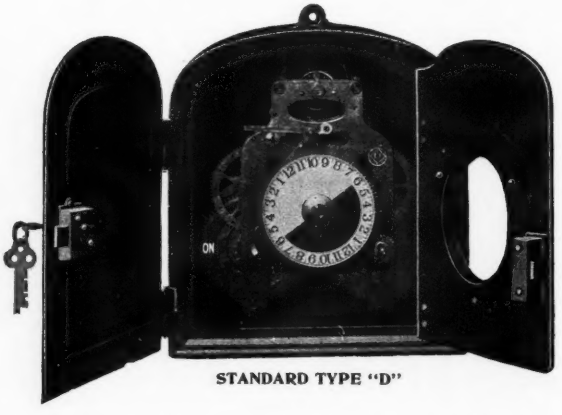

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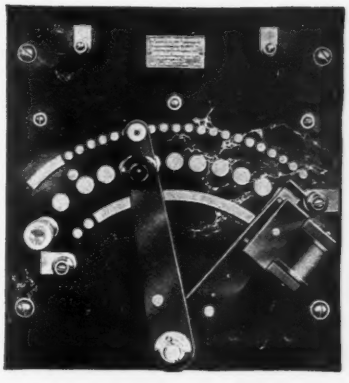

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HOW SIMPLY IT WORKS

The motor is started and brought to speed by moving the handle to the right, this handle being attached to the field regulator which is mechanically connected to the starter lever so as to move them as one piece in starting the motor. During this operation of starting the field resistance is short-circuited by an auxiliary contact mounted on the starter lever and a curved sector located just below the armature contacts. When the two levers have been moved to the position in which all resistance is cut out of the armature circuit, a keeper on the starter lever is attracted by the retaining magnet, and the starter lever is held in this position. At this time also the auxiliary contact above referred to has left the curved sector, thus removing the short-circuit from the field resistance. The field lever is now free for movement over the field rheostat buttons at the will of the operator, and may be left at any desired point, thus regulating the speed of the motor as desired. If the retaining magnet is de-energized either by failure of voltage or by operation of overload release devices, the starter lever is released and returns to the starting position, carrying with it the field rheostat lever.

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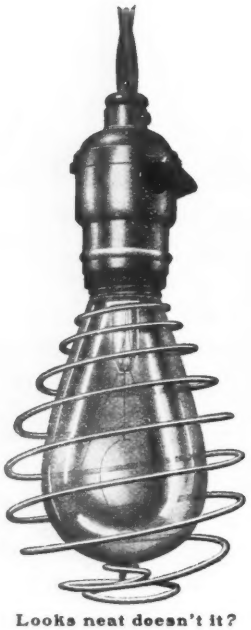

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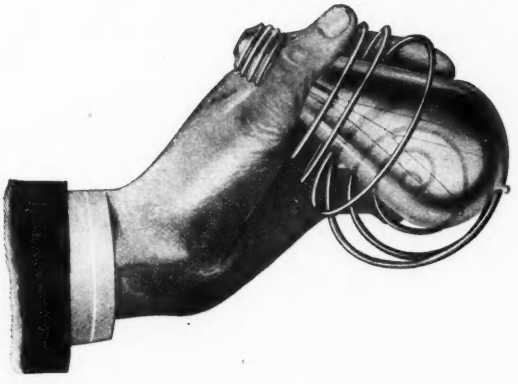

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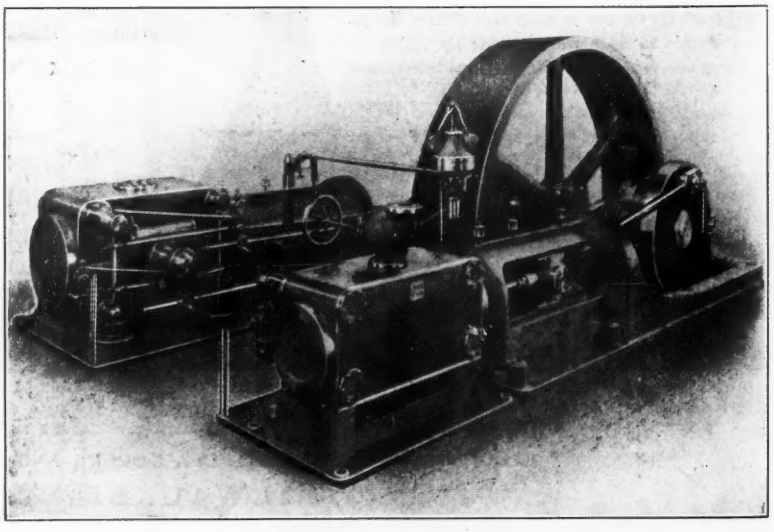

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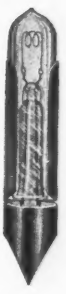

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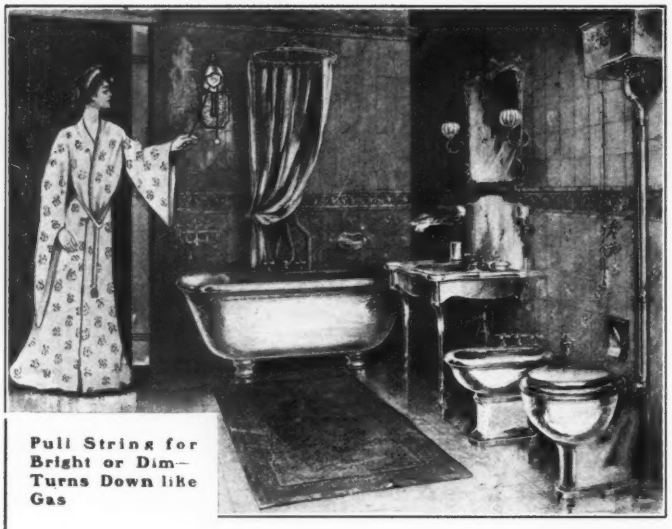

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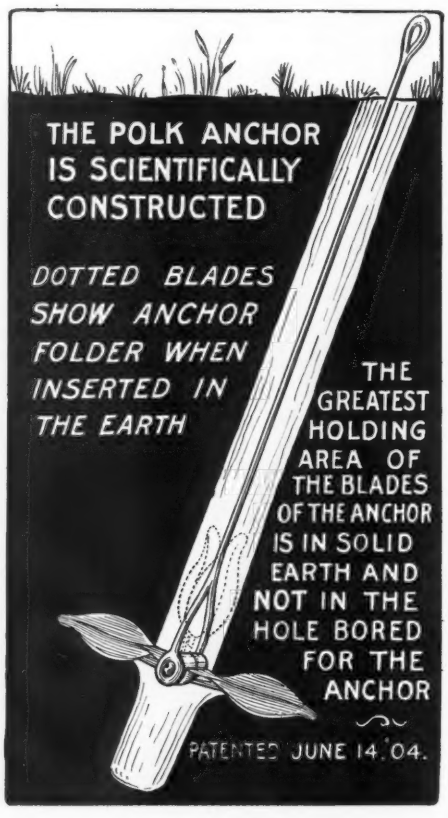
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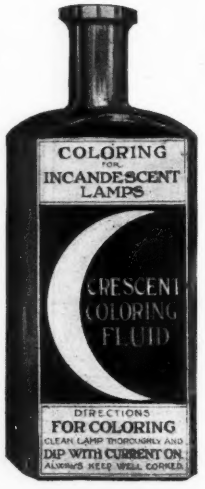
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Licensed Under Patents,

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No. 726293 Apr. 28, '03	No. 537498 Apr. 16, '95
No. 444530 Jan. 13, '91	No. 569142 Sept. 22, '96
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A Bryan-Marsh lamp burned brightly 800 hours and then without a word of warning went out--died! It wasn't "sick" even an hour. It burned at maximum brightness during the entire 800 hours. Its "death" came about in a peculiar manner. It seemed to realize that after 800 hours of "high-speed" service it would then be compelled to "go-slow"--or so to speak "burn dim." But rather than render an inefficient service it seemed to use a brain--it seemed to prefer to die--and die it did! Committed suicide to all intents and purposes.

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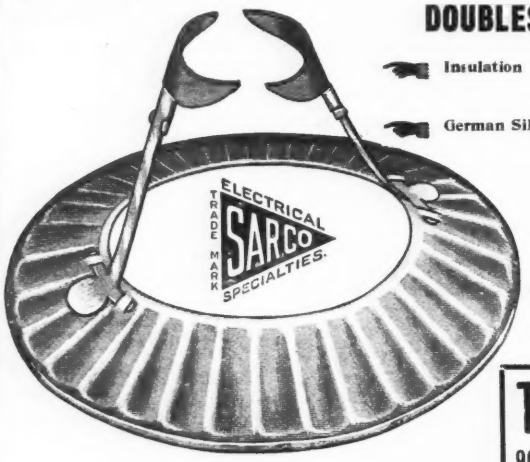

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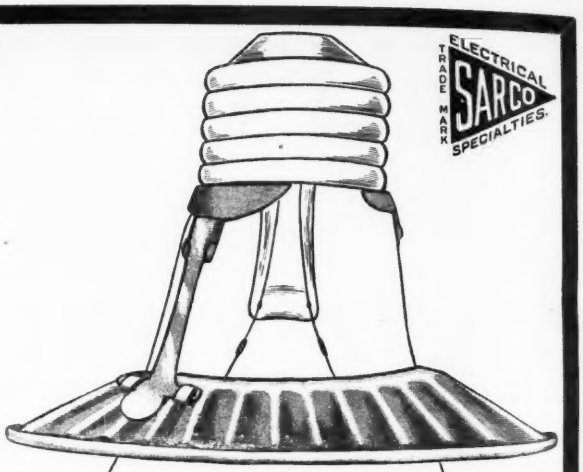

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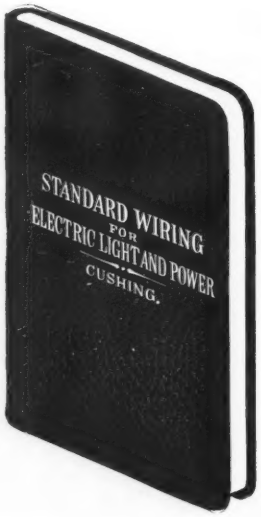

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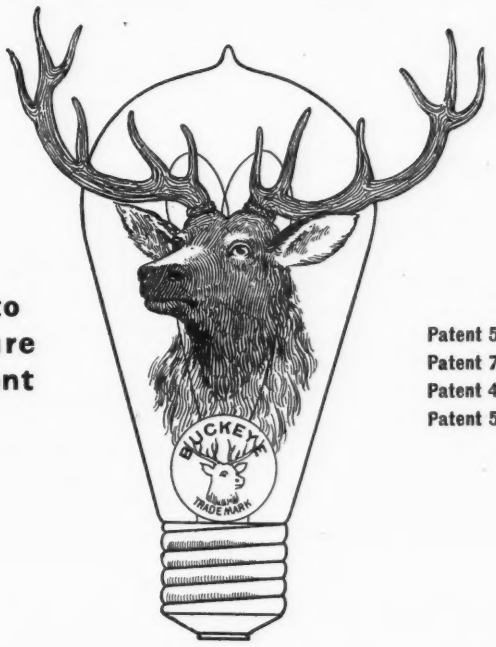

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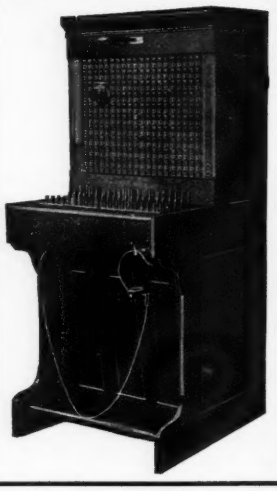

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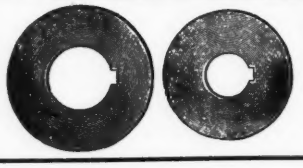

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It shows, more plainly than anything else, that in Lincoln, as in every other city where our **Automatic System** is in use, the people are quick to appreciate the superiority of **Automatic Telephone Service** and to vigorously support the company using it.

SUNDAY STATE JOURNAL, SUNDAY MORNING, NOVEMBER 13, 1904.

NOTICE!

We desire to notify our patrons and friends that we have discontinued the use of the Bell Telephone at our Wholesale Saddlery House, 808-814 P Street, for the reason that we believe that the Bell service should be furnished at no higher price than the automatic, and further, we find that most of our patrons have the Automatic service so we found it unnecessary to have both. Our Automatic store number is 2324; J. C. Harpham residence 3546; C. F. Harpham residence 2404.

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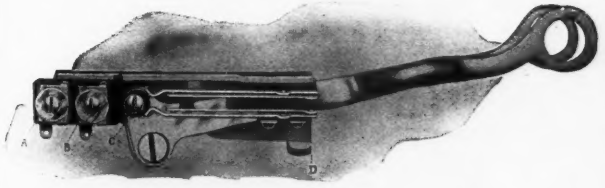

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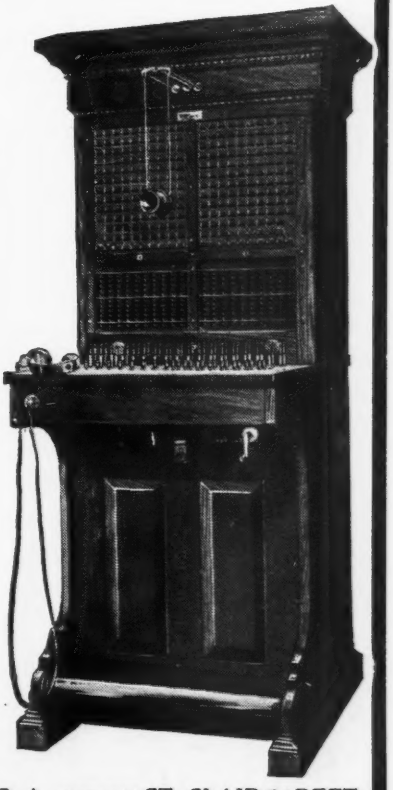

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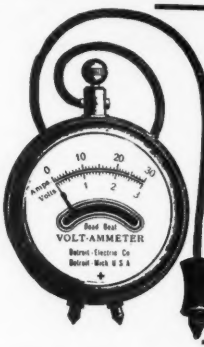

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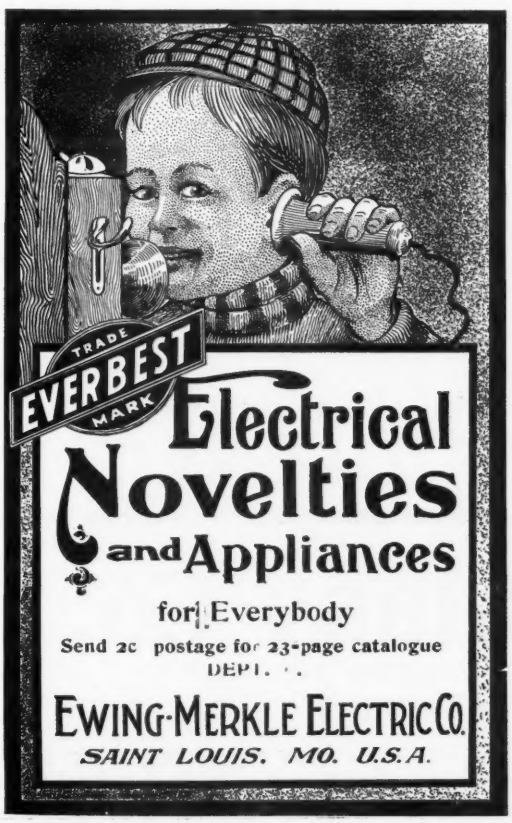

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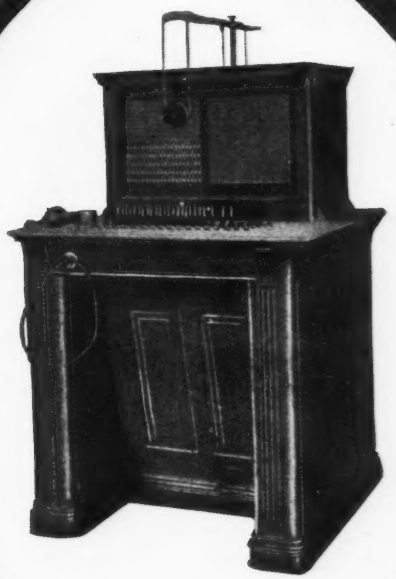

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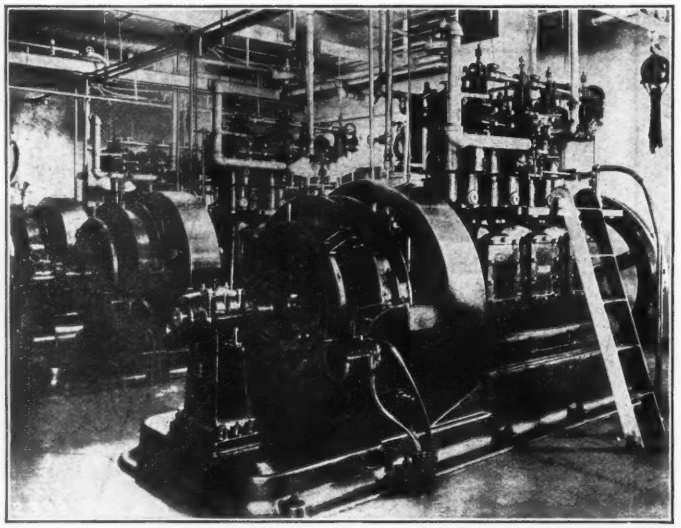

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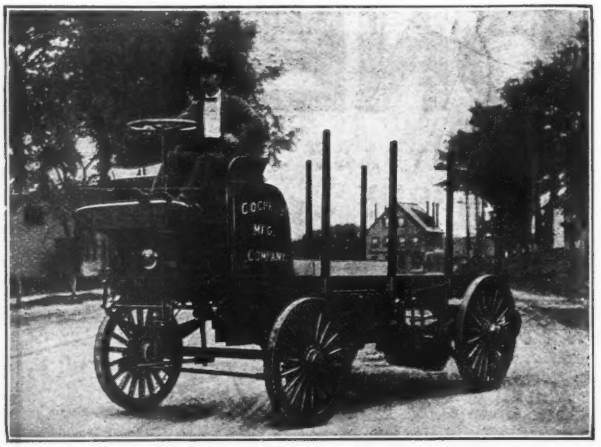

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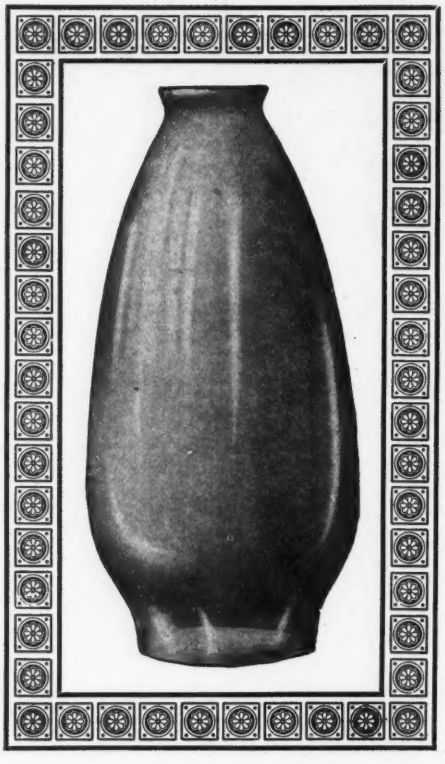

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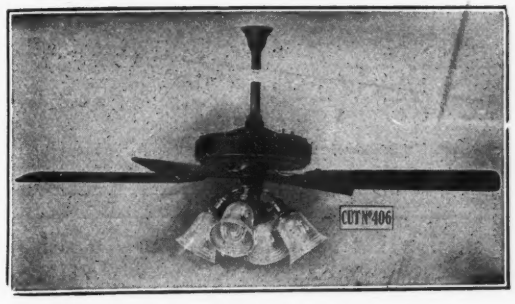

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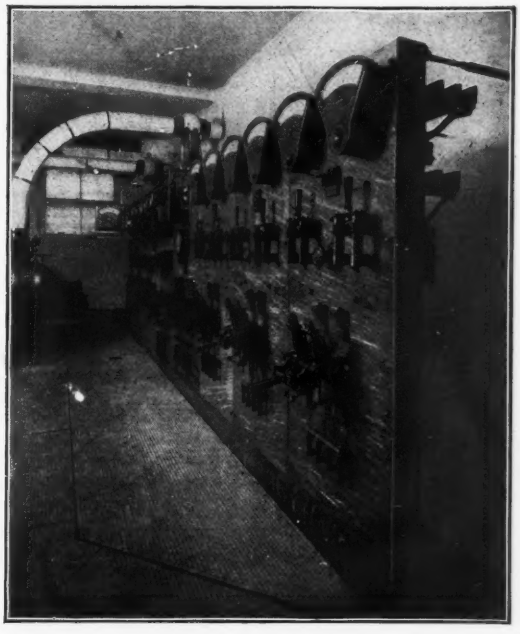

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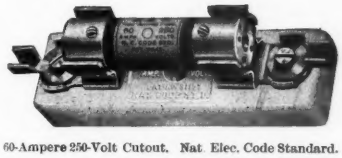
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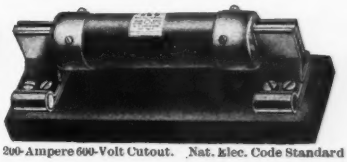
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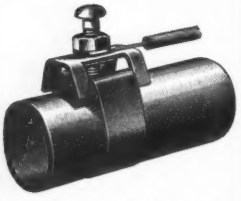

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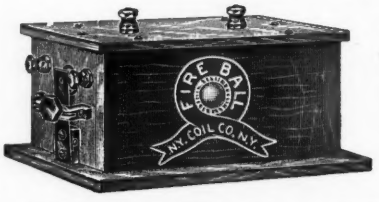

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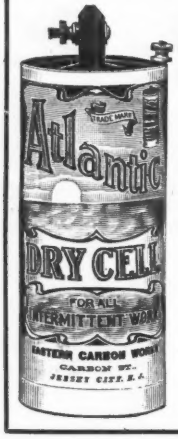

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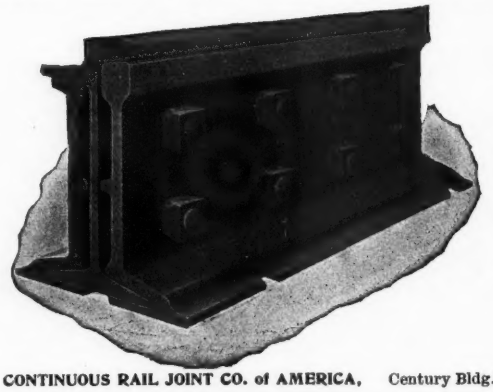

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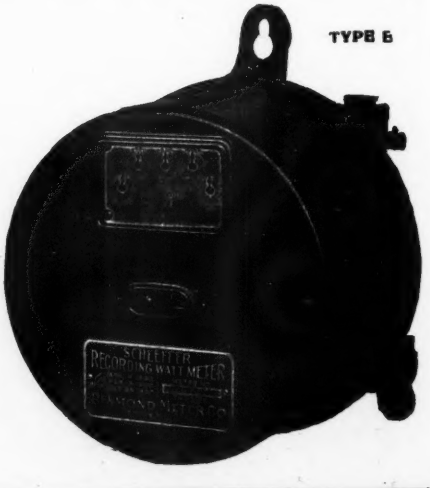

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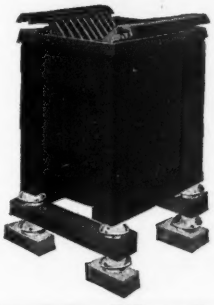

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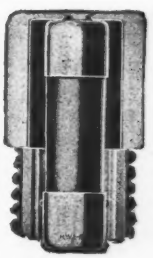

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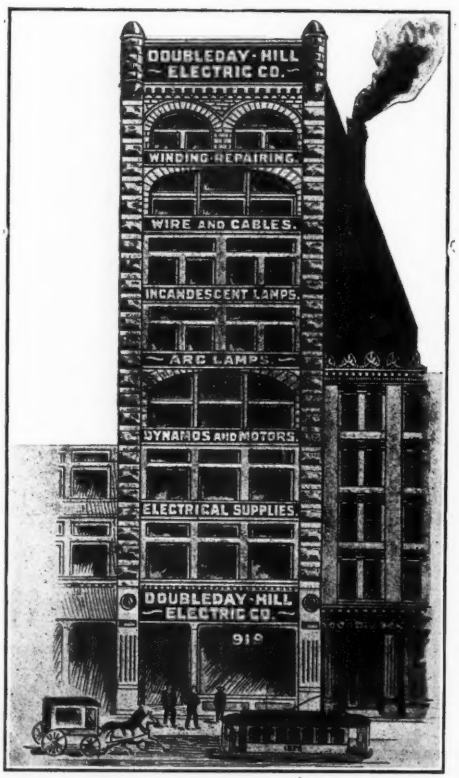

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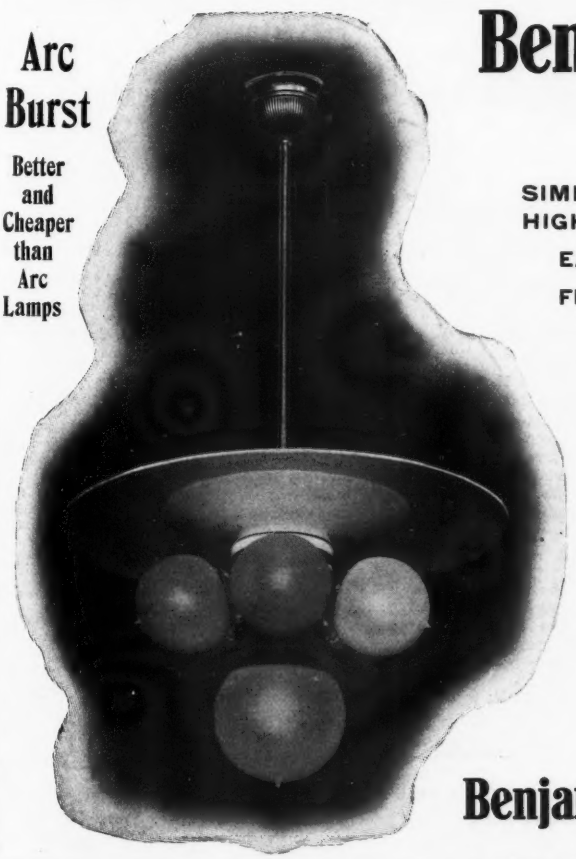

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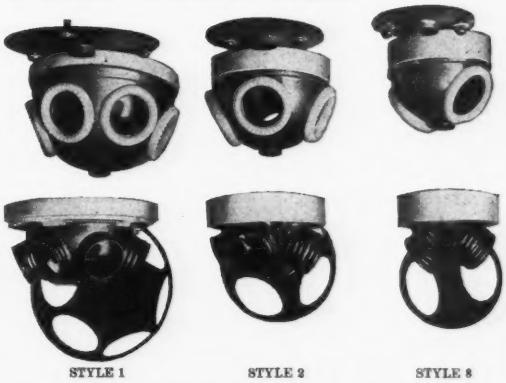

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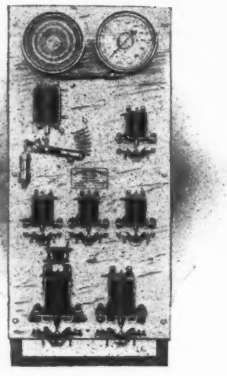

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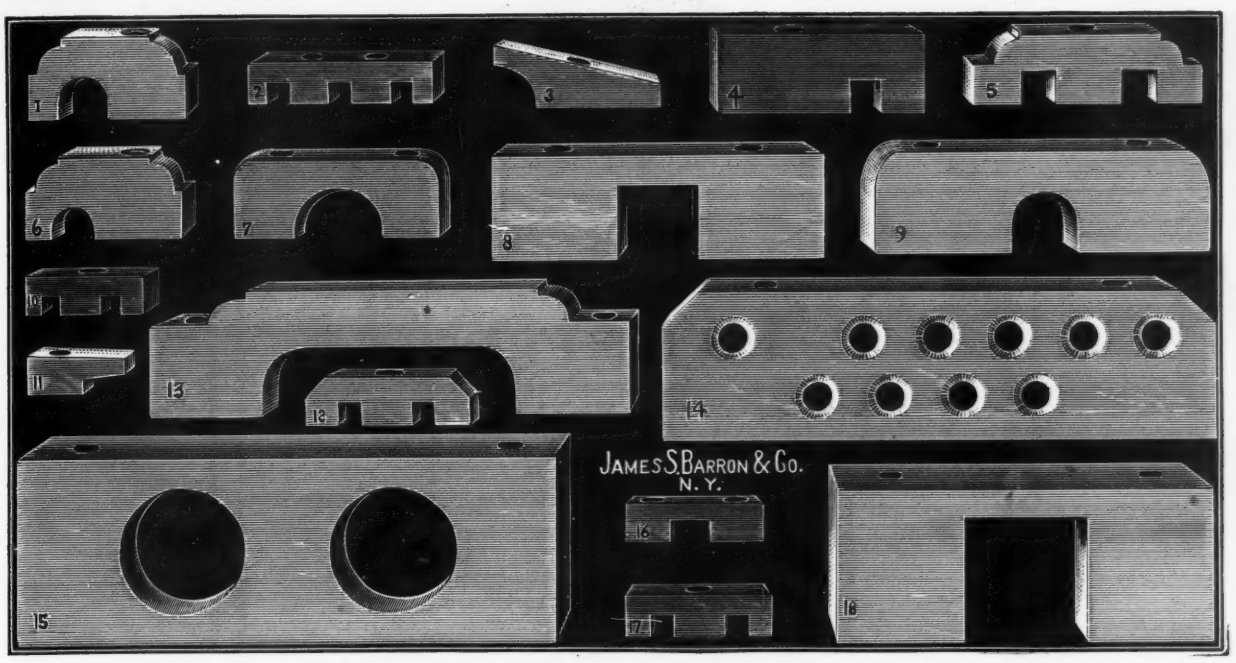

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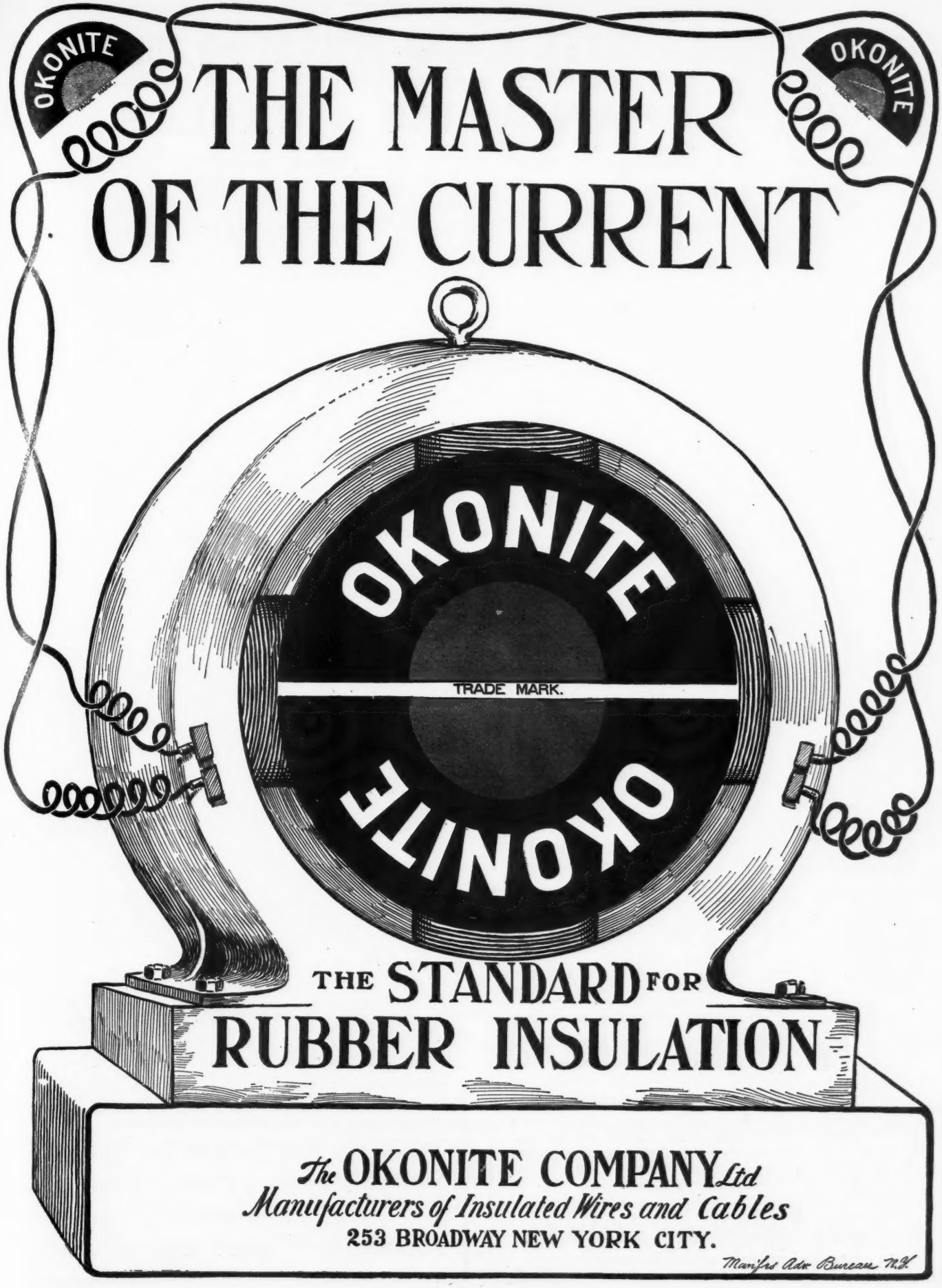
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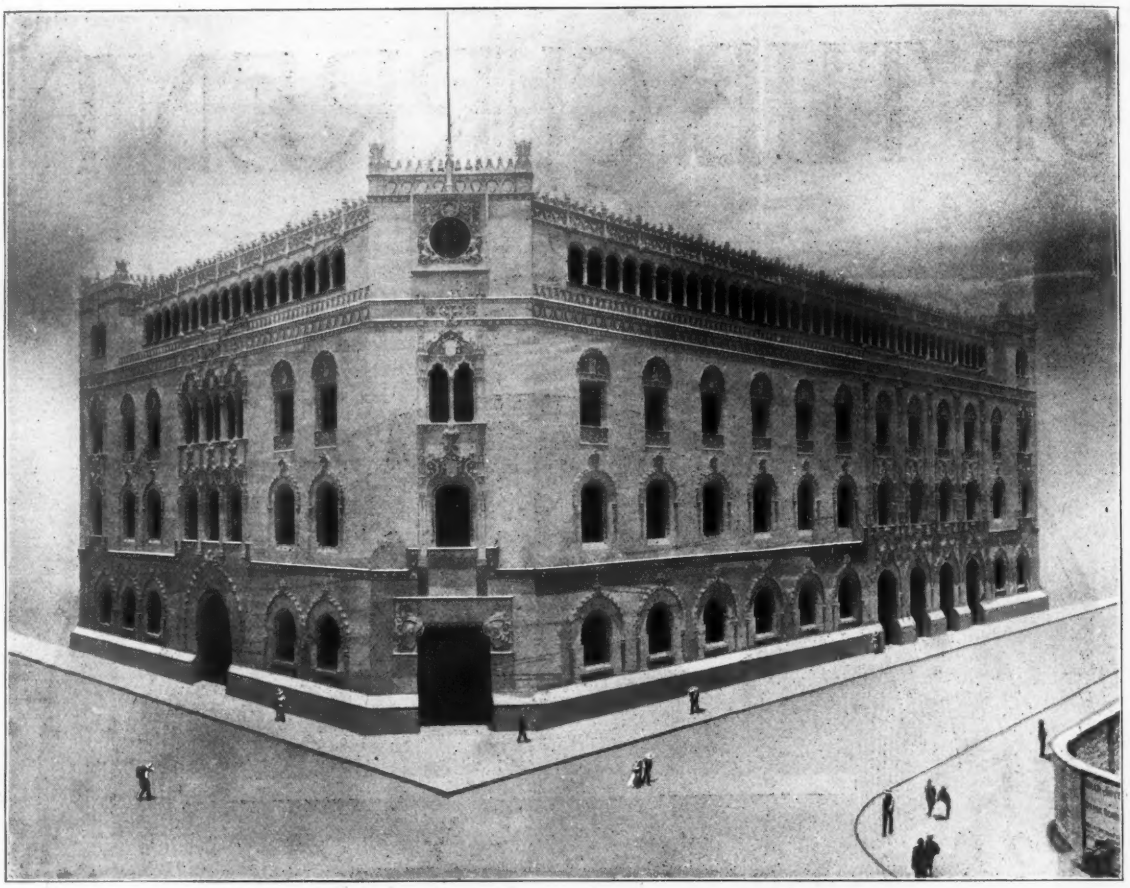

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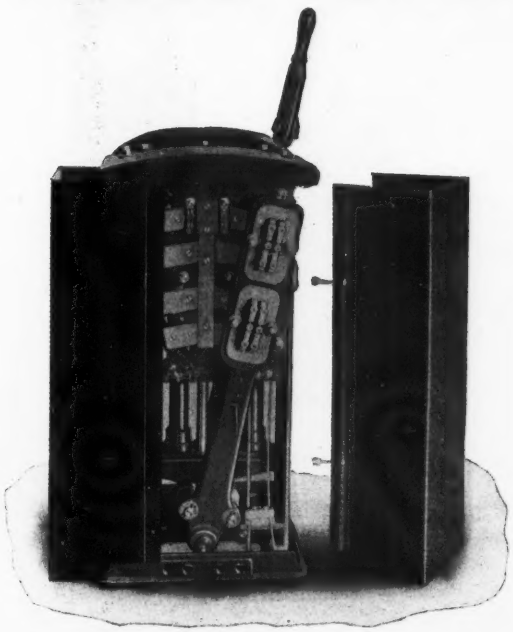

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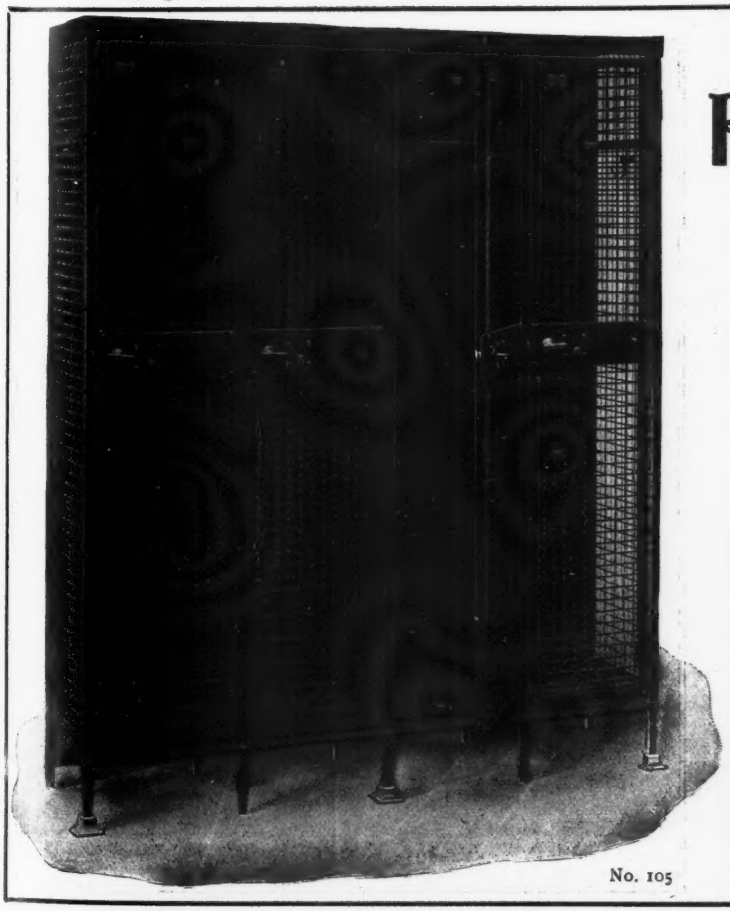

No. 105

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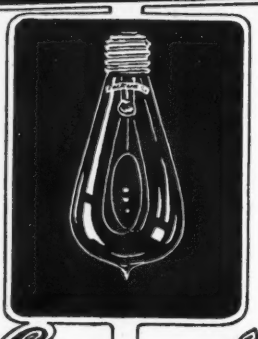

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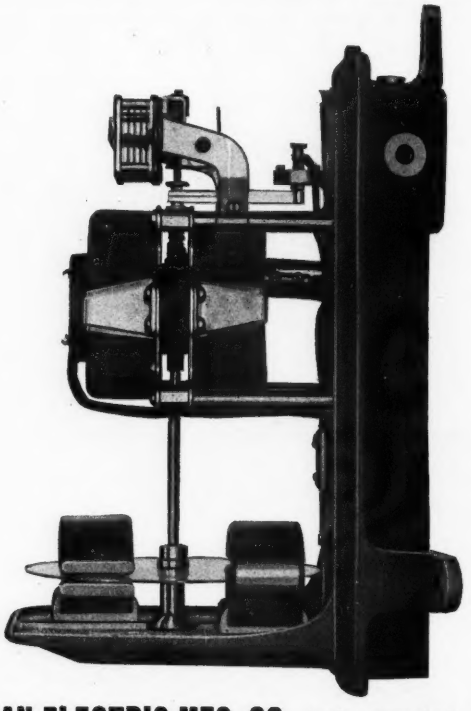

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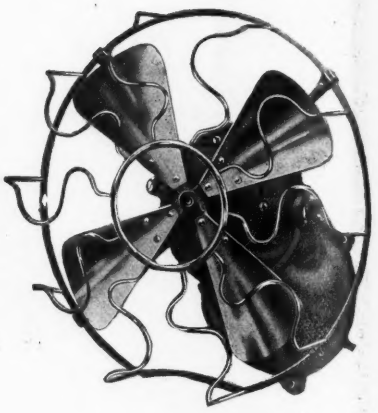

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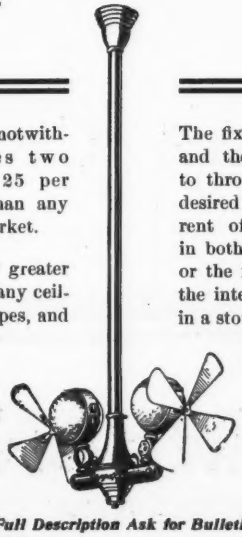

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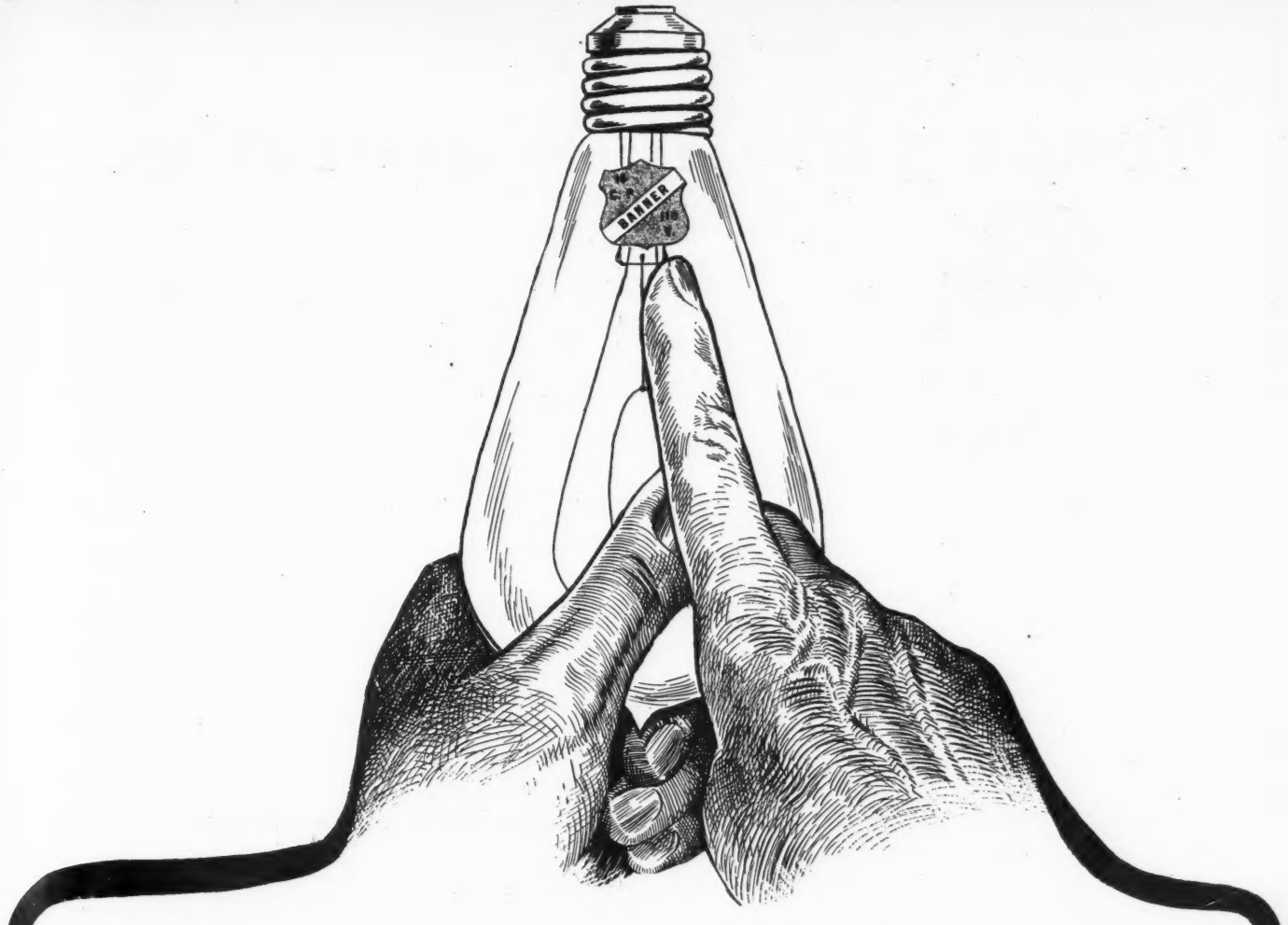

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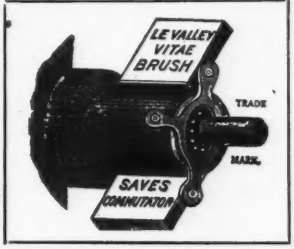

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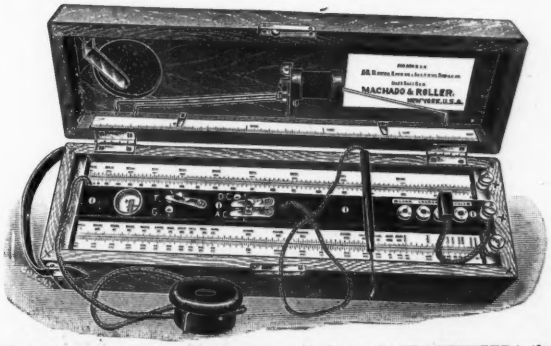

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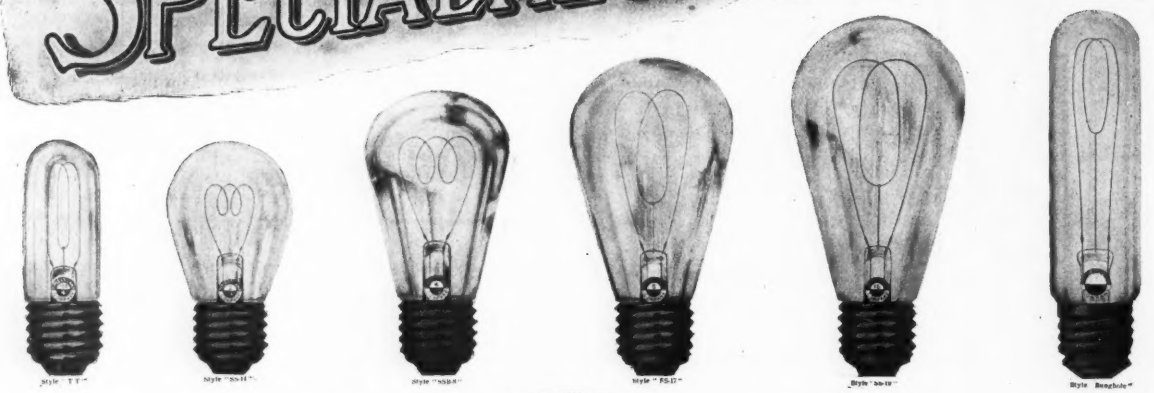

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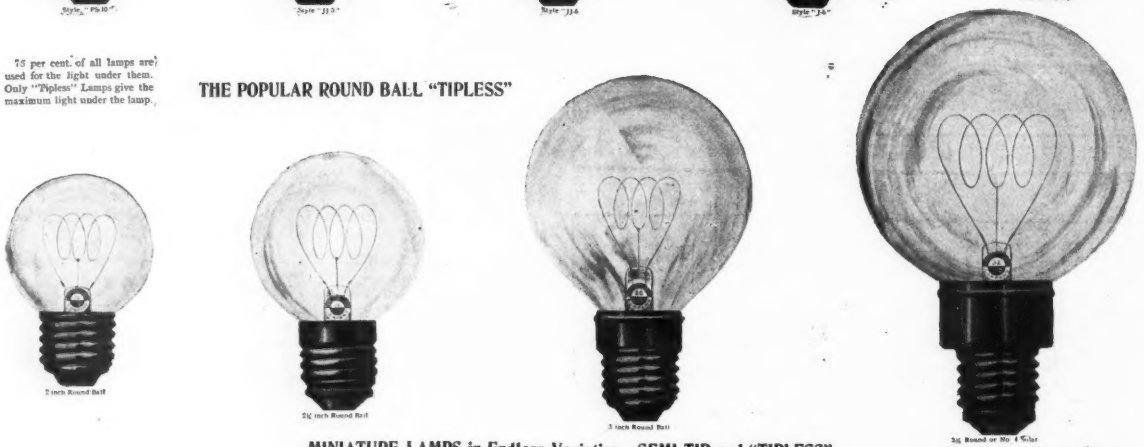

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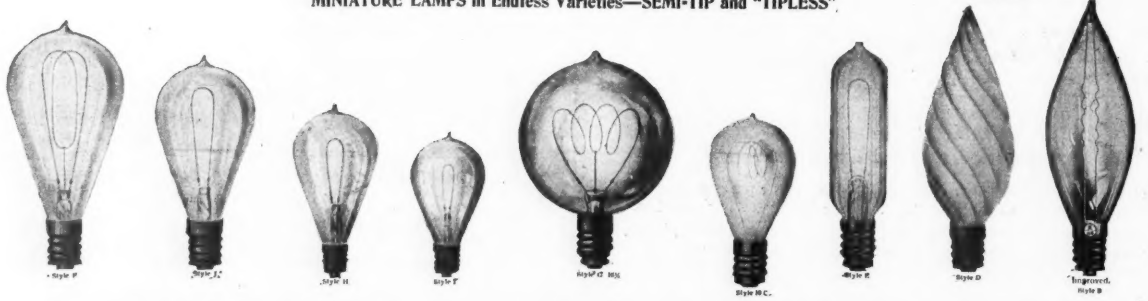

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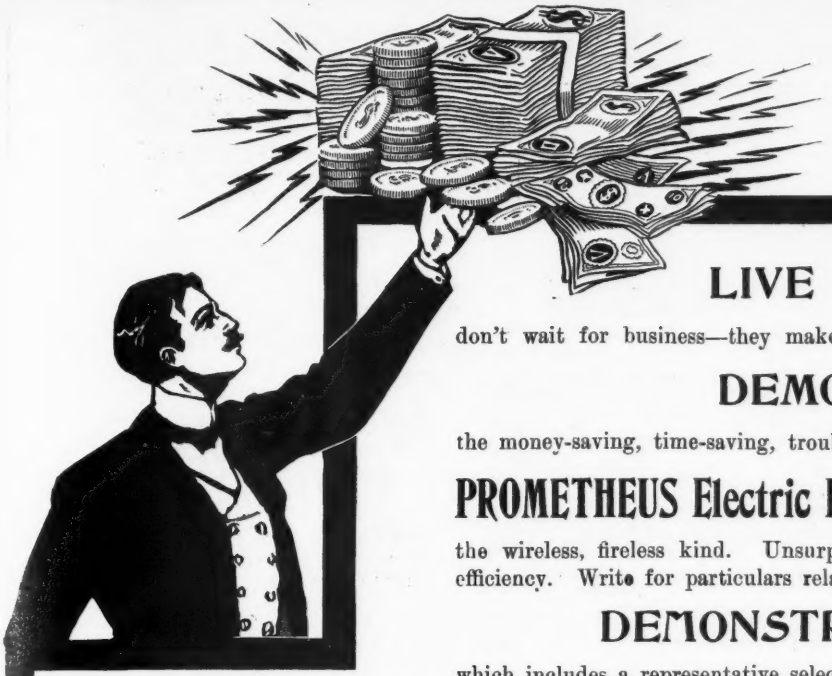

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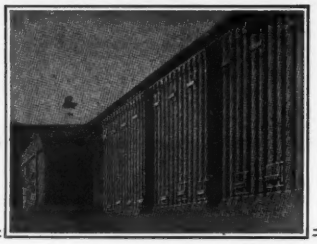

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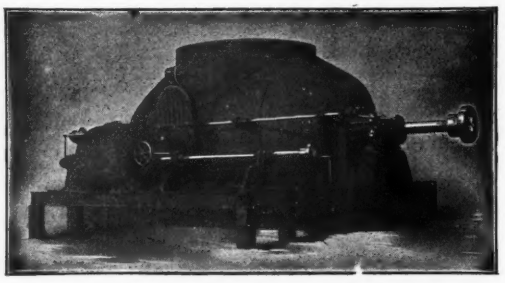

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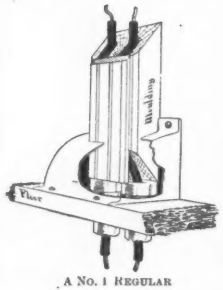

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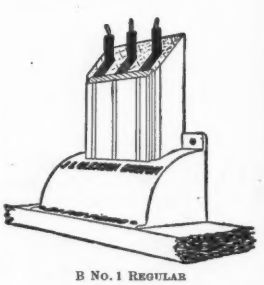

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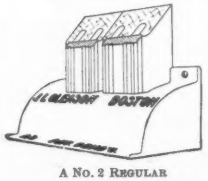

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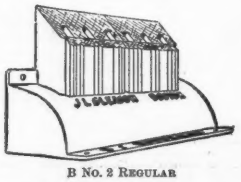

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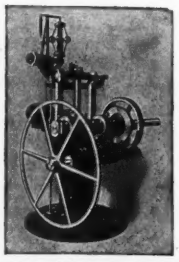

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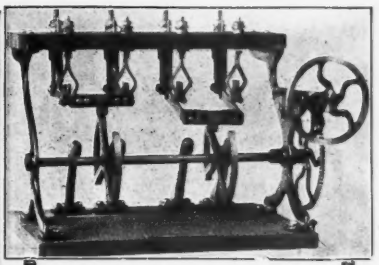

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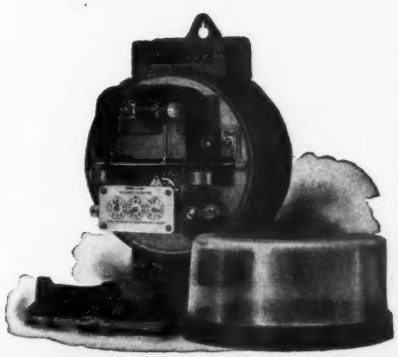

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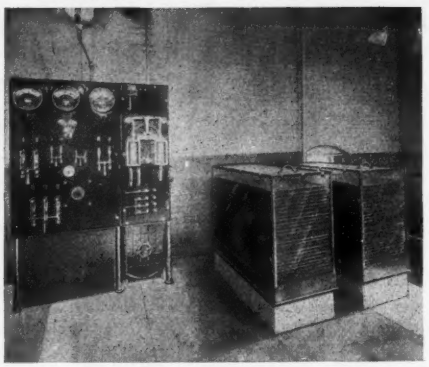

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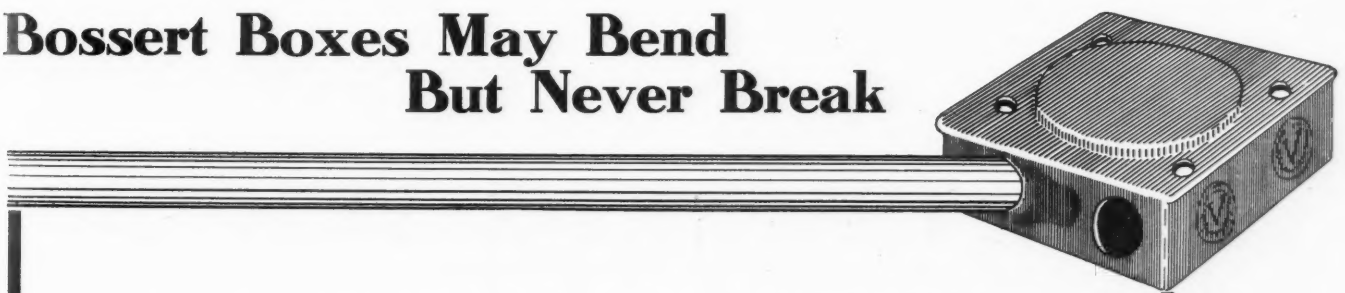

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For Electric Light and Power

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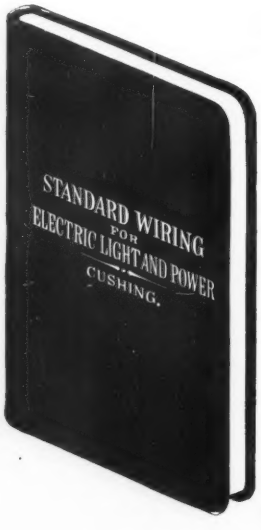

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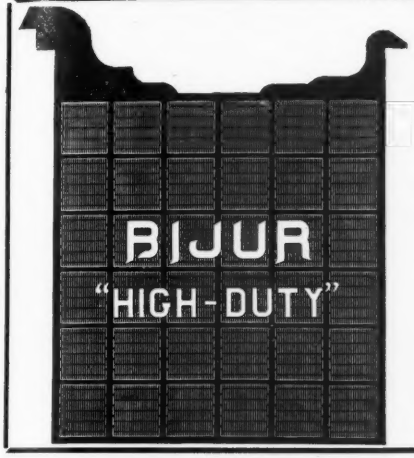

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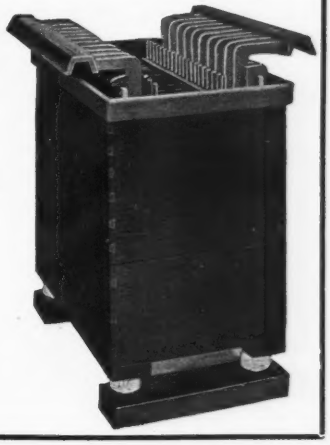

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Consulting Electrical Engineering for Municipalities and Isolated Plants

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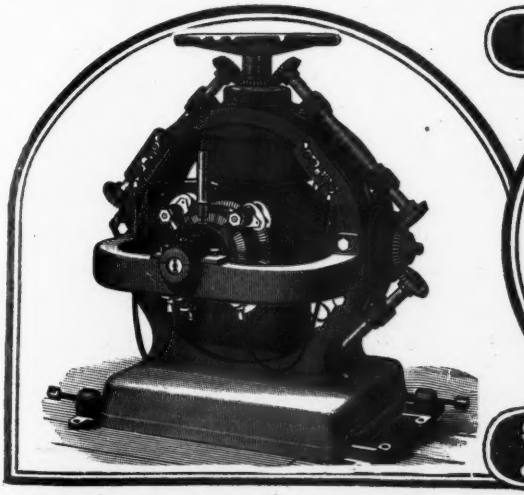

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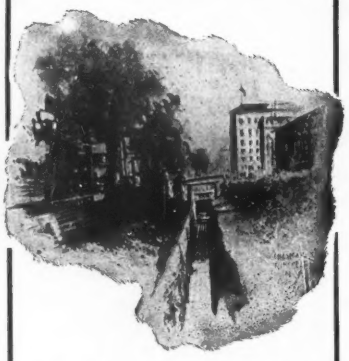
For Underground Electrical Construction



The American Conduit Company has a corps of experts in underground construction and is prepared to furnish supervision of work if desired. We would prefer to co-operate with contractors in underground construction, but if desired will submit estimates and bids and take contracts for completed underground systems in any part of the United States or Canada.

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CLASSIFIED INDEX—*(Continued from page 28)*

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Platt Iron Works Co.

ALTERNATORS
Fort Wayne Electric Works
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Warren Electric Mfg. Co.
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General Electric Co.
Hobart Electric Mfg. Co.
Holtzer-Cabot Electric Co.
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Jantz & Leist Electric Co.
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MANUFACTURED IN SIX STYLES

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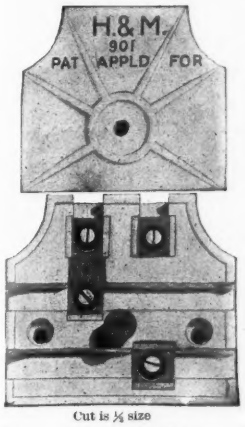
902	2	"	"	"	DOUBLE	2	" "	100
903	3	"	"	"	SINGLE	2	" "	100
904	3	"	"	"	DOUBLE	2	" "	50
905	3	"	"	"	SINGLE	3	" "	50
906	3	"	"	"	DOUBLE	3	" "	50



Cut is ½ size

By using the "H. & M." Moulding Branch Blocks, all disadvantages in making branches are done away with. Time is saved, simply place the blocks where branches are desired. The main line of moulding can be completed, and branches finished afterwards. By the old method, branches have to be spliced before main line can be finished. **Consider these advantages.** Write to-day for prices, discounts, etc., to your jobber or to the manufacturers.

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soldering of joints.
exposed wire.
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Stand Alone for

SAFETY
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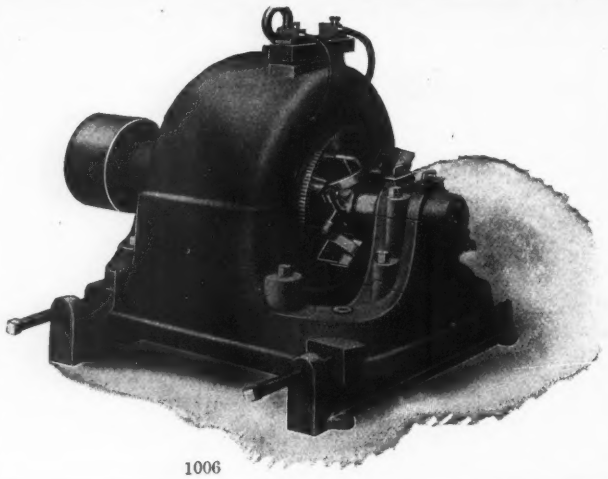

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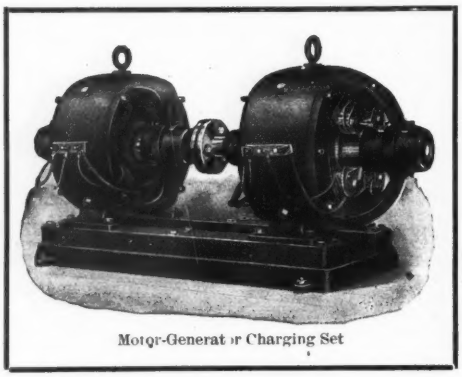

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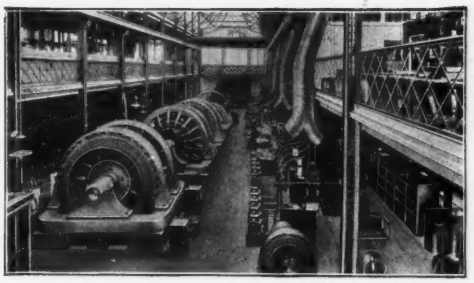

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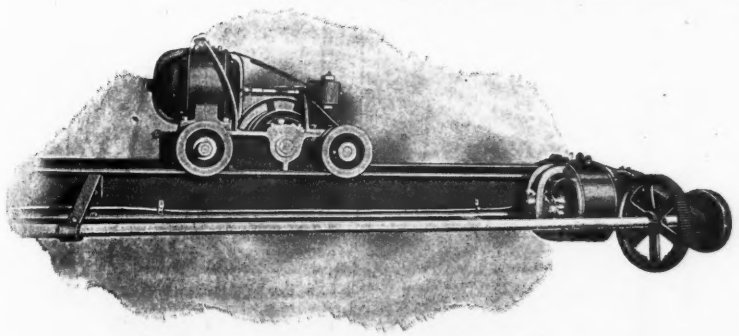

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Triumph Generators are unexcelled for either power or lighting service.

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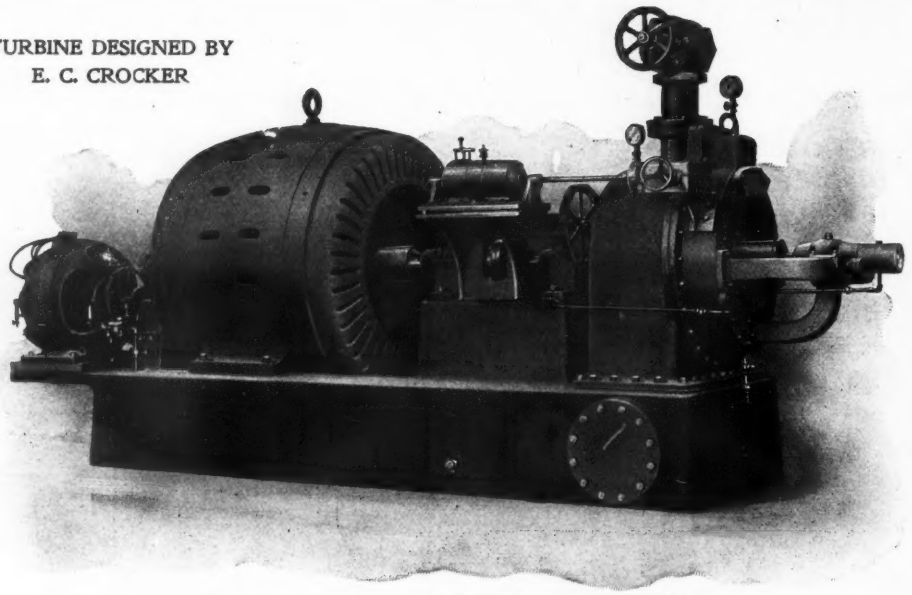
The Warren Steam Turbine-Alternator

TURBINE DESIGNED BY
E. C. CROCKER



Built in sizes from 100 K. W. to 3,000 K. W.

In the design and construction of these units we have accomplished the following features, distinct from other types.

Small floor space required.

Few parts, all of simple construction.

Multiple valve control, giving perfect automatic speed regulation WITHOUT THROTTLING.

The steam consumption per hour per horsepower is practically the same for all loads.

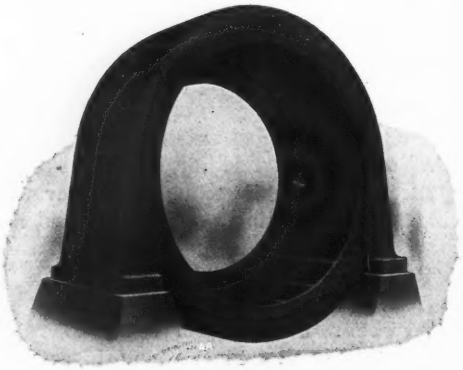
The theory is right—the construction is right, so write for Bulletins.

We are now building two 750 K. W. Warren Turbine-Alternator Sets for the U. S. Government, Boston Navy Yard.

WARREN ELECTRIC MFG. CO., Sandusky, Ohio, U. S. A.

WATER-WHEEL ALTERNATORS

ANY SIZE



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Four 4000 K. V. A. for Chicago Sanitary District.
Two 2000 K. V. A. for the Huronian Company.

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Crocker-Wheeler Company

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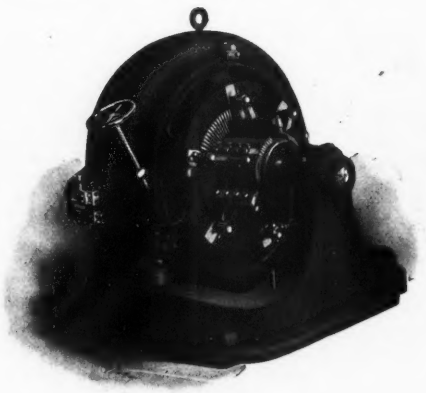

New York Office

B. S. BARNARD & CO.
39 Cortlandt Street

Transformer Decision Reversed

On May 3d the United States Court of Appeals for the Southern District of New York handed down a decision in the case of the Westinghouse Electric and Mfg. Co. vs. the Montgomery Light and Power Co., involving Stanley Patent No. 469,809, ***reversing*** a decision of the Lower Court favorable to the Westinghouse Company.

This decision of the Court of Appeals ***favorable to the Montgomery Light and Power Co.*** is one step in a long line of litigation having for its object a monopoly of the manufacture, sale and use of standard transformers such as used by all central station lighting and power companies.

Considerable publicity has been given the earlier decision by the Lower Court favorable to the plaintiffs, and this announcement of the reversal by the Court of Appeals will therefore dispel any misapprehension of the true merits of this litigation which may have arisen in the minds of central station people.

Users of Wagner apparatus may rest assured that this apparatus does not infringe the valid patents of other companies. It is the policy of the Wagner Company invariably to carefully investigate all the United States letters-patent bearing upon its lines of manufacture, and to so design its apparatus that the patents belonging to others, valid in the opinion of our attorneys, are in no sense infringed. The wisdom of this policy is evidenced by the fact that after thirteen years of continuous manufacture of all its standard lines there has been no patent decision against this company or its apparatus which has stopped the manufacture of a single line of product, or inconvenienced a single customer in any way.

The Montgomery Light and Power Co. is using types "M" and "MH" Transformers manufactured by this company.

TYPES "M" AND "MH"
"WAGNER" OIL-FILLED LIGHTING AND MOTOR TRANSFORMERS

Wagner Electric Manufacturing Company

ST. LOUIS, U. S. A.

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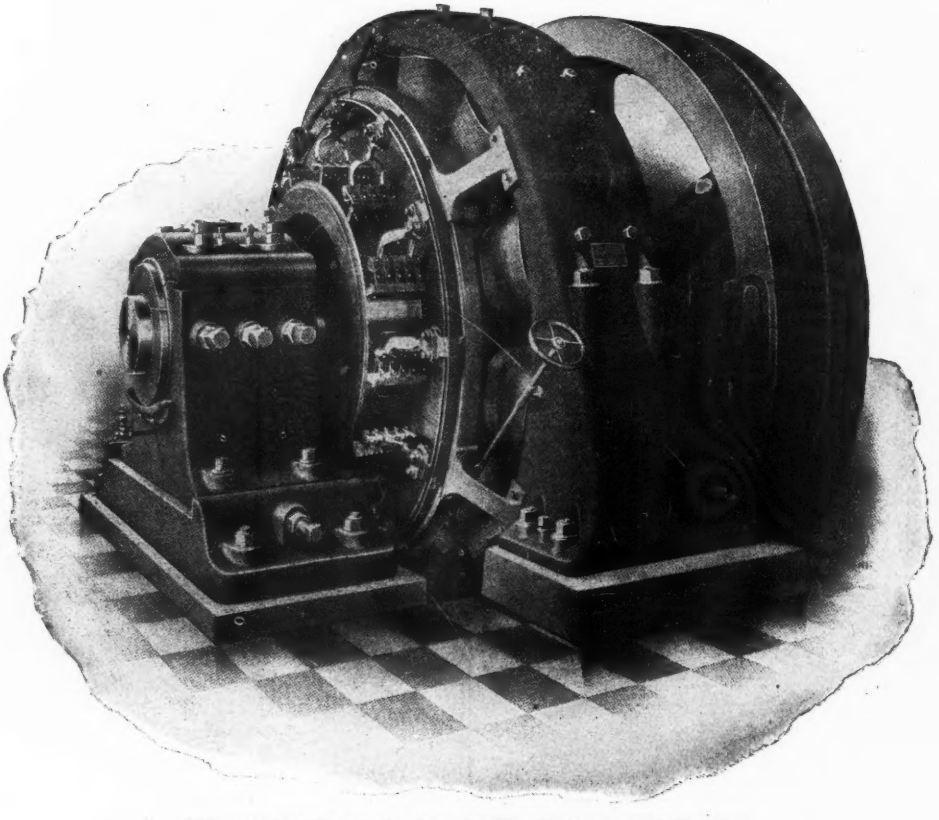
ENGINE TYPE GENERATORS

Possess all the Essential Features of a Perfect Running Machine



400 KILOWATT ENGINE TYPE THRESHER GENERATOR

Complete Equipments for Electric Railways, Lighting and Power Transmission

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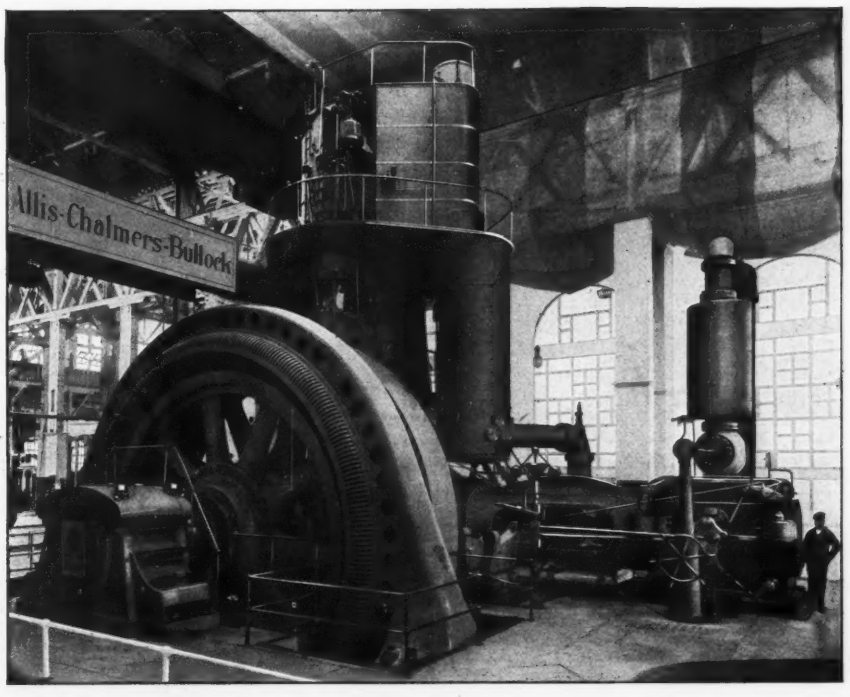


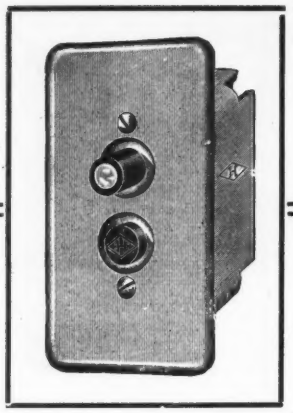
Single-crank "Manhattan" Type, 5,000 horse-power Engine, direct-connected to a 3,500 Kilowatt Bullock Generator
(Grand Prize, St. Louis, 1904)

An Ideal Central Station Unit

Occupies only two-thirds of the floor space required by a horizontal cross-compound engine, and permits vertical low-pressure cylinder with consequent minimum wear.
With this construction there is no liability of oil being thrown on the Generator.
Especially adapted for large powers.

ELECTRICAL DEPARTMENT
The Bullock Electric Mfg Co
CINCINNATI OHIO

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal



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TRADE MARK

Push Button Switches

Sheet mica insulation. Quick and positive action. Knife contacts. Mechanism insulated from current-carrying parts. Will fit wall appliances made for other Push Button Switches.

Rotary Flush Switches

"Diamond H" Rotary or Turn Handle Switches are of the same high-grade construction as the Push Button Switches.

The insulation is SHEET MICA.

The parts of the mechanism most subjected to wear, are made of hardened and tempered steel.

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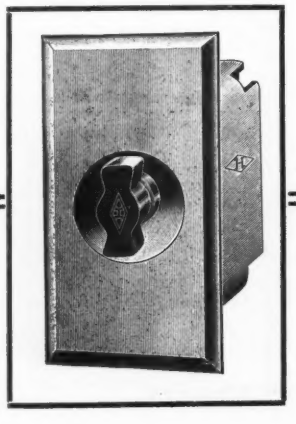

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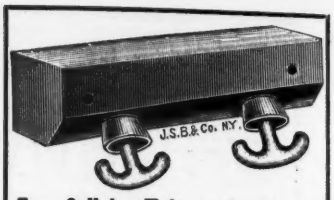

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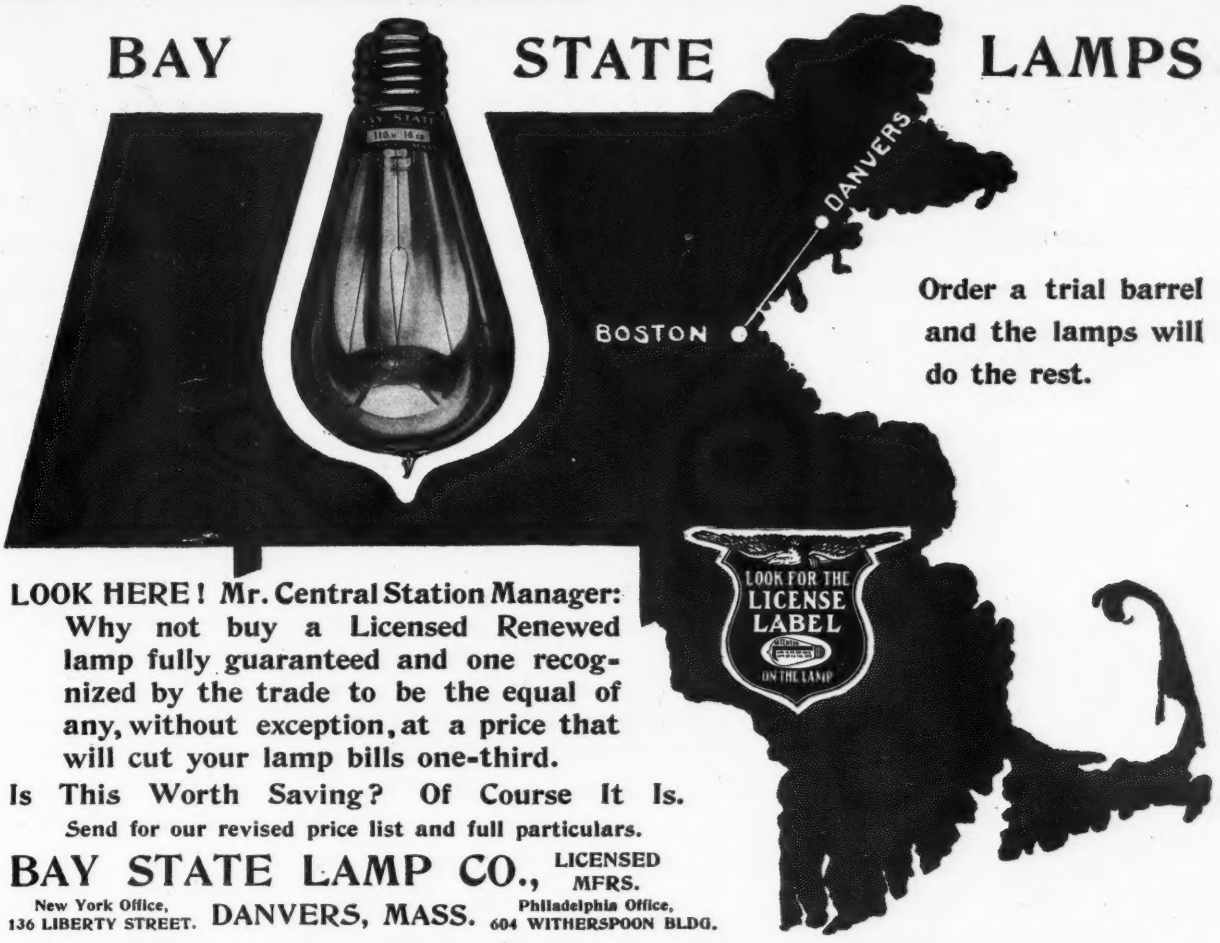

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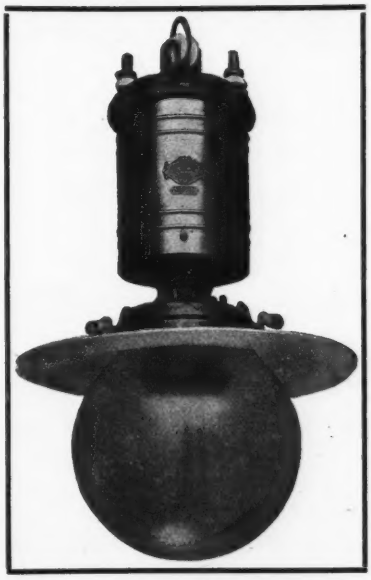

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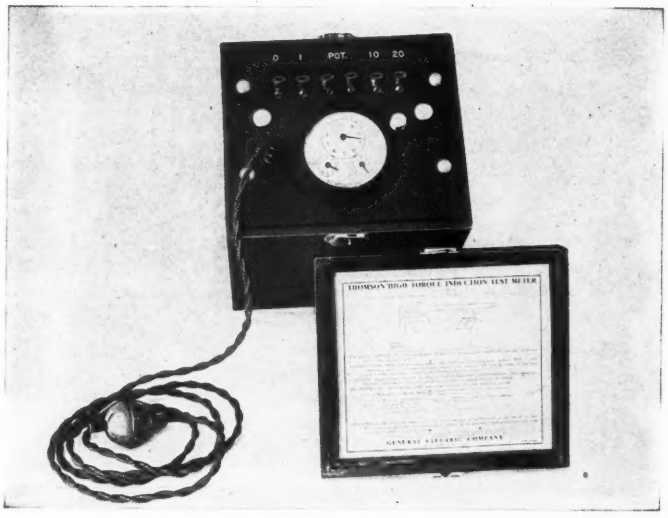

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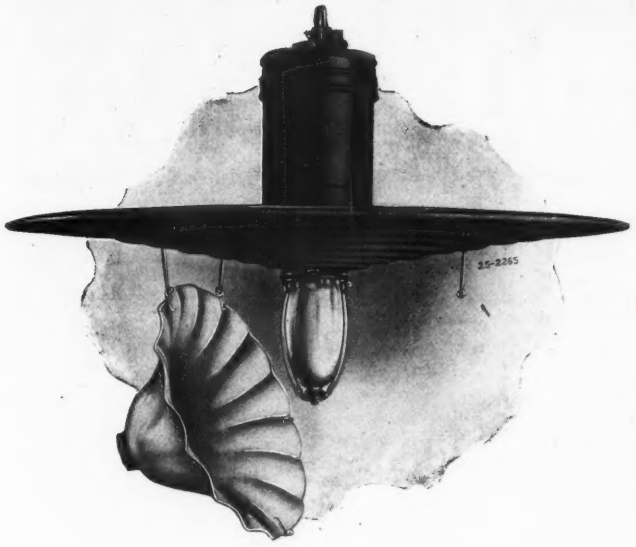

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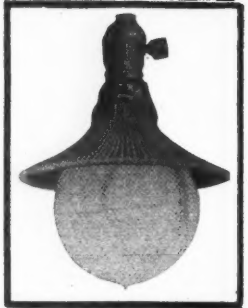

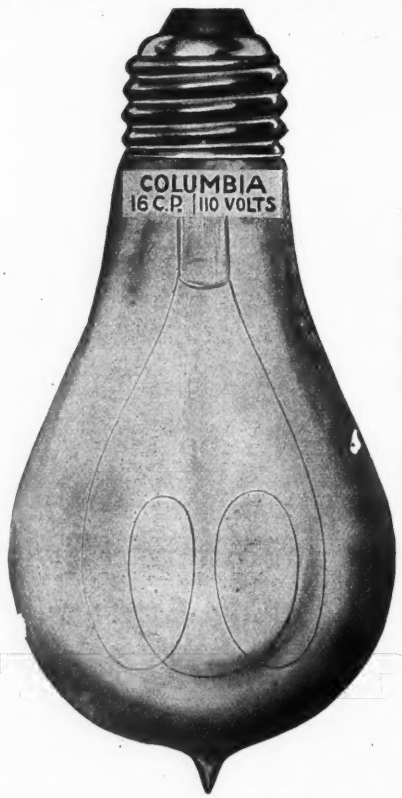

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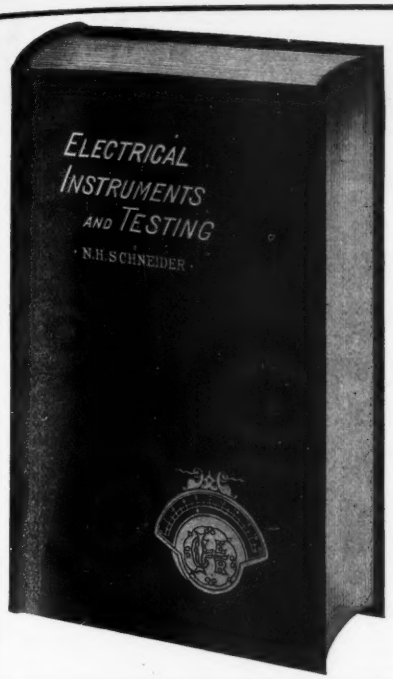

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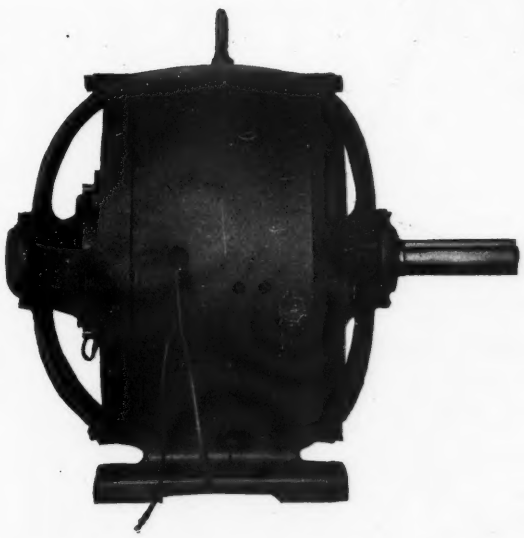

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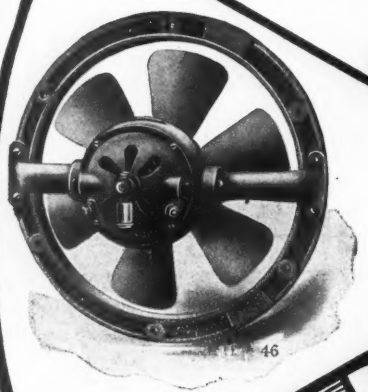

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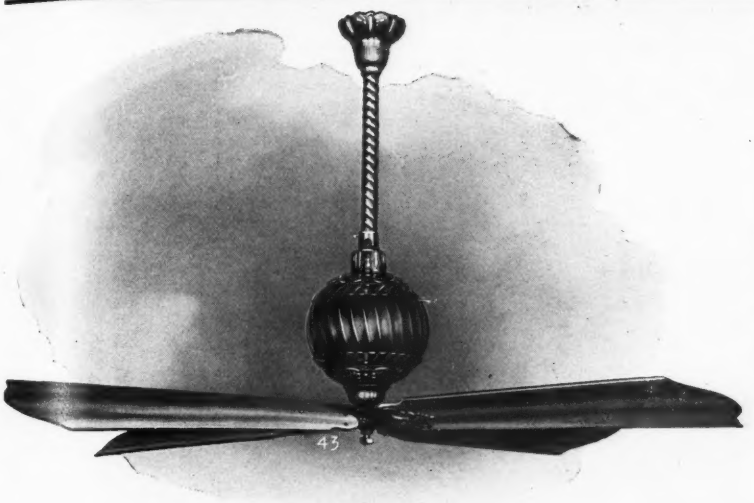

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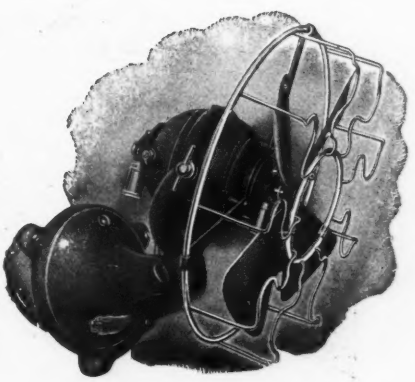

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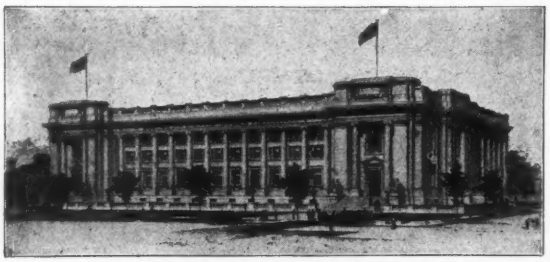

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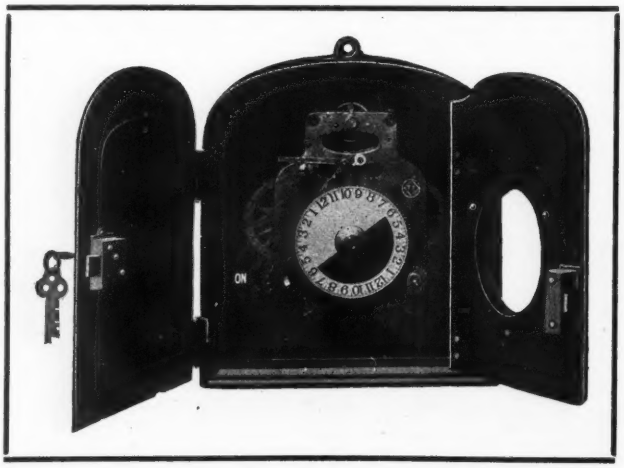

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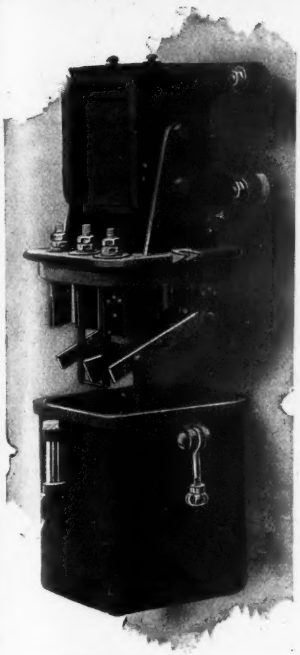

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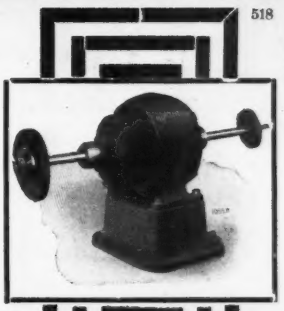

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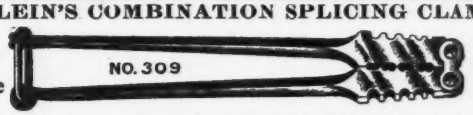

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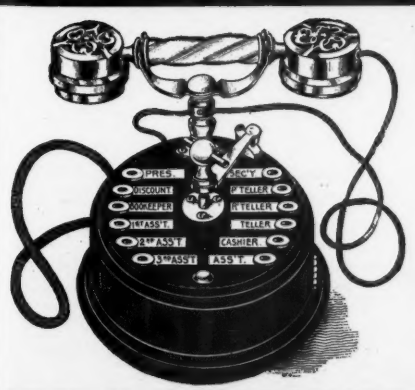

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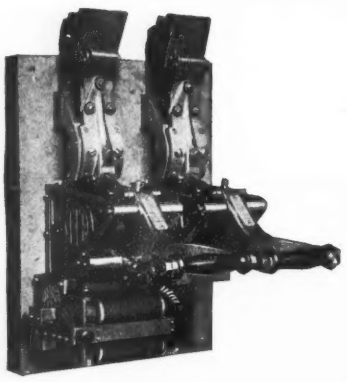

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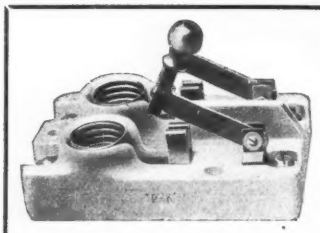

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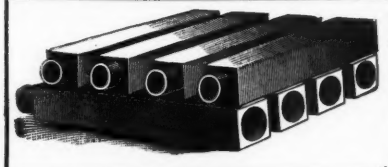

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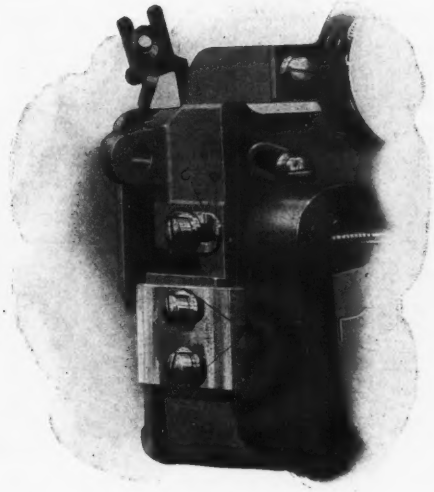
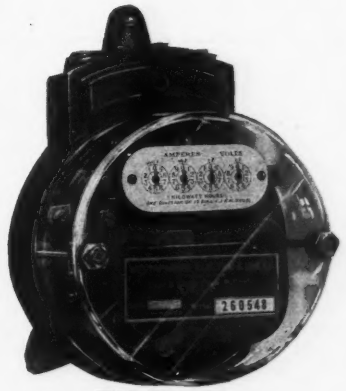
Type "B" Integrating Wattmeter

With Metal Cover





With Glass Cover

Adjustments

A. Friction Adjustment
B and C. Frequency Adjustment
D. Permanent Magnet Adjustment

Easy to Install

The fact that the Type B Meter is a sealed meter makes it easy to install. Other meters require releasing of the moving element before being placed in service. The mechanism of the Type B is adjusted at the factory ready for use, and is placed in service just as it leaves the hands of the inspector. Any lineman who can make proper connections, and take initial reading, can place the meter in service.

Easy to Adjust

If by any accident the calibration of the Type B Meter is destroyed, it can be readily readjusted by moving the slide which will give the adjustment desired. The center illustration shows these adjustments (see letters A, B, C, D). It will be noted they are all mechanical sliding adjustments, secured by set screws, which can be easily reached by removing the cover. There are no soldered adjustments, with danger of damage from acid fumes.

We have some interesting Wattmeter literature; write for it

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